RCRA FACILITY INVESTIGATION REPORT

EKCO HOUSEWARES, INC.
MASSILLON, OHIO

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SECTION 1

INTRODUCTION

1.1 PROJECT OVERVIEW

1.1.1 Project Objectives

Roy F. Weston, Inc. (WESTON®) was retained by American Home Products Corporation (AHPC) to conduct a Resource Conservation and Recovery Act (RCRA) Facility Investigation and a Corrective Measures Study (RFI/CMS) for the EKCO Housewares, Inc. (EKCO) facility in Massillon, Ohio. This report documents the results of conducting the RFI portion of the RFI/CMS. The work performed during the RFI was based on the requirements presented in the RFI/CMS Work Plan. This Work Plan was prepared by WESTON for the U.S. Environmental Protection Agency (EPA), Region V, and it was approved January 1991. The objectives of the RFI were to:

- Evaluate groundwater flow directions.
- Evaluate the horizontal and vertical extent of chemicals in groundwater.
- Evaluate the depth and extent of chemicals in soil.
- Identify potential sources of chemicals detected in soils and groundwater.
- Evaluate the effectiveness of the presently operating groundwater remediation system in recovering released chemicals.
- Evaluate the need for additional data to complete the RFI.

1.1.2 RFI/CMS Scope of Work

The RFI/CMS Scope of Work consisted of 11 tasks:

- Description of Current Conditions - Task I.
- Pre-Investigation Evaluation of Corrective Measures Technology - Task II.

- RFI Work Plan Requirements - Task III.
- RFI - Task IV.
- Investigation Data Analysis - Task V.
- RFI Report - Task VI.
- Identification and Development of the Corrective Measure Alternative(s) - Task VII.
- Laboratory and Bench Scale Studies - Task VIII.
- Evaluation of the Corrective Measure Alternative(s) - Task IX.
- Recommendation of the Corrective Measure or Measures - Task X.
- CMS Report - Task XI.

As part of the groundwater investigation, straddle packer tests were performed on two monitor wells (R-1 and R-2). Thirteen additional monitor wells were installed. Pumping tests were performed on five wells screened in the glacial outwash. Groundwater sampling, laboratory analysis, and water level measurement of monitor wells were also performed as part of the groundwater investigation. Potential sources of hazardous constituents to groundwater were characterized as part of Task IV. Three potential source areas were evaluated during the RFI:

- Tank area at southwestern end of the plant.
- Sump at production well W-10.
- Tank area at northern end of the plant.

Soil borings were drilled in these areas and soil samples were analyzed for volatile organic compounds (VOCs).

During Task V, data collected in Task IV were reviewed to ensure that the data were of sufficient quantity and quality to describe the nature and extent of contamination. In addition, the data were compared to appropriate standards to assess the potential threat to human health and the environment. The requirements of the RFI report are contained in the Work Plan. The RFI report contains the following information:

- Site description.
- Environmental setting.
- Summary of field investigation.
- Results of the investigation.
- Evaluation of data.
- Conclusions.

1.2 FACILITY BACKGROUND

1.2.1 Facility Location

The EKCO facility occupies approximately 13 acres of land located in the town of Massillon, Stark County, Ohio (Figure 1-1). The area immediately surrounding the facility is largely urban and industrial, although land use to the northwest is more rural with a larger proportion of open space. The EKCO property is approximately triangular in shape and is located approximately 1,500 ft west of the Tuscarawas River. The northern border of the facility is Newman Creek, the western border is the Penn Central Railroad, and the eastern border is the Baltimore and Ohio Railroad.

A variety of businesses are located adjacent to the EKCO plant. These include Ohio Packaging (paper) to the south, sand and gravel quarries to the west and northwest, Carter Lumber (retail) and Price Brothers (concrete pipe manufacturing) to the north, and the Ohio Water Service (OWS, public water supply) waterworks to the east and northeast. A relatively large, inactive municipal landfill exists just east of the OWS facility. The Baltimore and Ohio Railroad owns numerous spurs and sidings east of and adjacent to the EKCO plant that are used for the storage of rail cars and track maintenance vehicles.

1.2.2 Facility History

A summary of the history of the EKCO facility is presented in Table 1-1. In the 1940s, the EKCO facility manufactured aluminum and stainless steel cookware. By 1951, with the

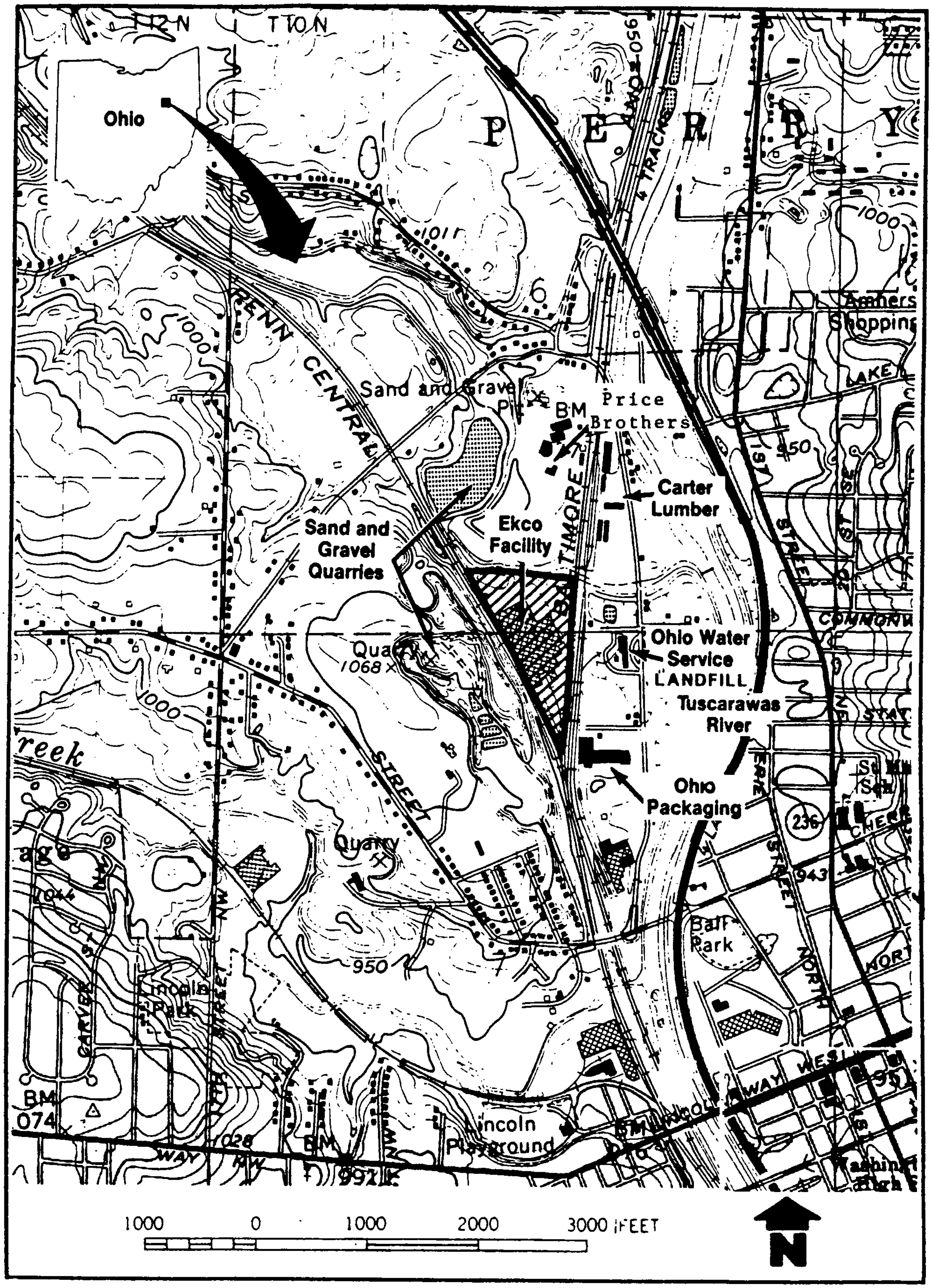


FIGURE 1-1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

Table 1-1

EKCO Facility History

Date	EKCO Site History
Ca 1929-32	First recorded activities at facility. Property is owned by Standard Oil Company.
Ca 1929-42	Fort Pitt/Massillon Bridge Works - Manufacture of iron and steel bridges and structural iron.
1945	Manufacturing Aluminum and stainless steel cookware.
1950	Production wells W-1 and W-2 were installed and put into service to produce water for plant activities. Well W-1 has been used continuously since then, and well W-2 was used until it was taken out of service in the late 1970s.
1951	The plant began with the U.S. involvement in the Korean conflict manufacturing 90-mm and 105-mm shell casings for the military. This increase in production necessitates the drilling of two production wells (W-1 and W-2).
1953	A surface impoundment was constructed along the northern property boundary adjacent to Newman Creek, Sludge frame waste treatment was discharged to it. Began copper-plating cookware, used primarily TCE or 1,1,1-TCA to clean cookware.
1964	Stopped using TCE; 1,1,1-TCA was used in its place.
1965	AHPC acquired EKCO Housewares.
1967	Installation of porcelain and teflon coating units.
1969	Surface impoundment meets newly formed NPDES regulations and permits.
March 1986	The air stripper system was installed and put into service.
July 1974	NPDES Permit No. C-3094BD was issued to EKCO.
1977	EKCO discontinued the manufacturing of aluminum and porcelain cookware and the use of the lagoon ceased.
1978	All copper plating operations ended; the principal manufactured products were pressed and coated nonstick bakeware.
1979-1980	The only major documented solvent spill to date at the facility was recorded; neither the exact location nor the extent of the spill was documented.
1980	The surface impoundments was reactivated under the existing NPDES permit and received housing alkaline degreaser filter water.
March 1984	In applying for a renewal of their NPDES permit, the plant was required to analyze on-site well water for VOCs, this analysis indicated the presence of 1,1,1-TCA and TCE.
June 1984	All discharges to lagoon ceased.
1984	AHPC sold EKCO Housewares to the EKCO Group.
May 1992	EKCO reported a 330-gallon 1,1,1-TCA spill to EPA. EKCO removed 50 tons of soil from the area of the solvent release.
Present	EKCO continues to manufacture pressed and coated nonstick bakeware. A silicon-based compound is presently used to coat the bakeware to create the nonstick surface.

United States becoming involved in the Korean Conflict, the plant began manufacturing 90-mm and 105-mm shell casings for the military. The resulting increase in production necessitated the drilling of two production wells at the facility (W-1 and W-2, as shown in Figure 1-2). In 1953, a sewer was constructed that carried the plant waste to a discharge point along Newman Creek. At approximately the same time, a surface impoundment was constructed along the northern property boundary adjacent to Newman Creek. Sludge from waste treatment was discharged to the surface impoundment.

During 1954, EKCO began coating cookware manufactured at the facility. Chlorinated solvents [primarily trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA)] were used to clean the products prior to coating, although these solvents were never used by EKCO at the same time. Between 1954 and 1964, EKCO used TCE for cleaning parts; EKCO changed its process solvent to 1,1,1-TCA in 1964 and has used TCA since then.

In 1965, AHPC acquired EKCO Housewares. Porcelain and teflon coating units were installed at the EKCO facility in 1967. In 1969, with the development of new [National Pollutant Discharge Elimination System (NPDES)] regulations and permit requirements, a permit was issued by the State of Ohio for the surface impoundment to discharge waste products associated with plant activities. The waste products permitted for discharge included:

- Deionizers from copper coating operations (hydrochloric acid and sodium hydroxide).
- Washings and waste material from manufacturing porcelain-teflon coated aluminum cookware (aluminum frit, various pigments: inorganic oxides of lead, cadmium, selenium, and cobalt).
- Alkaline washer fluids to clean aluminum cookware.

In July 1974, NPDES Permit No. C-3094BD was issued to the EKCO facility. As the 1970s progressed, EKCO discontinued the manufacturing of aluminum and porcelain cookware. Use of the surface impoundment ceased in 1977. By the end of 1978, all copper coating

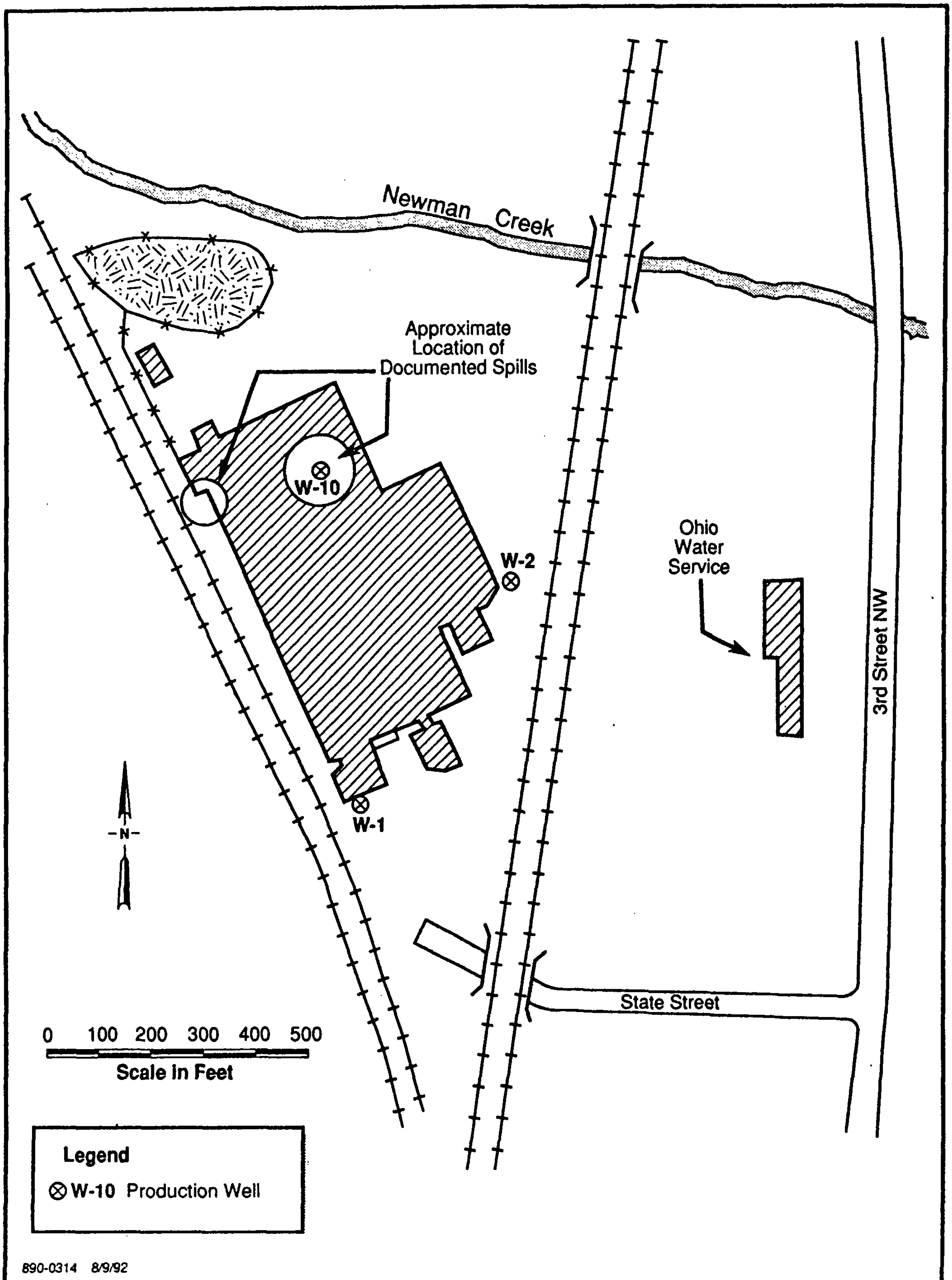


FIGURE 1-2 APPROXIMATE LOCATION OF THE ONLY DOCUMENTED SPILLS

operations had ended, and the principal products manufactured at the facility became pressed and coated nonstick bakeware.

There have been only two documented solvent releases at the facility. Correspondence between EKCO and the Ohio Environmental Protection Agency (OEPA) identified a solvent release that occurred between 1979 and 1980 in the vicinity of production well W-10 (Figure 1-2). Neither the exact location nor the extent of the spill was documented. Well W-10 is located in a sump covered by a grate mounted flush with the plant floor, and the well head sump may receive floor drainage. In May 1992, EKCO reported to EPA a release of 330 gallons of 1,1,1-TCA in an area northwest of the plant. In response, 50 tons of soil were excavated in the presence of an OEPA representative. The soil was containerized and transported to the Enviro Safe Services of Ohio, Inc. hazardous waste landfill in Toledo, Ohio.

The surface impoundment was reactivated in 1980 under the existing NPDES permit and received alkaline degreaser filter water until mid-1984. In 1984 AHPC sold the facility to EKCO Group, Inc. In March 1984, when the plant applied for a renewal of its NPDES permit, analysis of on-site well water for VOCs was required. The analysis indicated the presence of 1,1,1-TCA and TCE. This discovery resulted in subsequent investigations at EKCO. These investigative activities are described in Subsection 1.3 of this report. EKCO continues to manufacture pressed and coated nonstick bakeware at the Massillon facility. A silicon-based compound is presently used to coat the bakeware to create the nonstick surface.

1.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

A summary of the previous environmental investigative activities conducted at the EKCO facility is presented in Table 1-2. These activities are discussed below. Floyd Brown and Associates, Inc. (FBA) conducted the first environmental investigations at the facility between 1984 and 1987. WESTON has conducted all subsequent environmental investigations at the facility since 1987.

WESTON MANAGERS DESIGNERS/CONSULTANTS

Table 1-2

Previous Environmental Investigative Activities

Date	Event
1984	Discovery of 1,1,1-TCA and TCE in the groundwater beneath the EKCO facility. Sampling done by Wadsworth Testing Laboratories, Inc.
Fall 1984	Seven test holes were drilled, four in the overburden and three in the bedrock. Two of the overburden holes were completed as 1¼ inch (i.d.) piezometers and the three bedrock holes were completed as 6 inch (i.d. casing) bedrock wells (R-1 through R-3).
July 1985	An additional bedrock well (R-4) was installed along the eastern boundary. No VOCs were found.
February 1986	W-10 was converted into a recovery well for a pump and treat system. An air stripper was installed on-site. The discharge of the stripper was directed to Newman Creek.
June 1986	FBA developed a preliminary closure plan for the lagoon. Phase I of the plan called for 12 soil borings. No VOCs were detected in any of the borings.
January/February 1987	A more intensive soil boring (Phase II) was conducted by FBA. The program consisted of 25 soil borings. Four of the borings were completed as 1½-inch PVC wells to monitor the lagoon.
July 1987	WESTON was contracted to develop a final closure program for the lagoon and to develop a groundwater quality assessment program.
September 1987	Weston conducted a baseline assessment of the EKCO facility, which included sampling of all on-site wells including OWS Well 4, collecting data, OVA readings, construction and water level measurements, surveying on-site wells, groundwater utilization survey, and reviewing of plant records.
February 1988	WESTON began monthly sampling of OWS Wells 1, 2, 3, and 5. These wells were sampled until March 1990.
June/July 1988	Installation of 13 monitoring wells, eight of which were installed to characterize the stratigraphy of water bearing zones, to determine the depth of bedrock and to assess the hydraulic interconnection between the unconsolidated sand, gravel, and clay aquifer and the Pottsville sandstone. The other five wells were installed in accordance with RCRA Part 265, Subpart F for surface impoundment closure.
December 1988	WESTON performed a soil gas survey to identify potentially contaminated areas. In these areas, WESTON took soil borings to determine the vertical extent of any contamination. WESTON also sampled all on-site wells including the on-site production wells.
May 1989	WESTON initiated the quarterly sampling of the five lagoon wells (L-1 through L-5).
April 1991	WESTON conducted packer tests to evaluate the extent of interconnection between overburden and bedrock wells.

Table 1-2

Previous Environmental Investigative Activities (Continued)

Date	Event
June/August 1991	WESTON installed 13 monitoring wells to evaluate off-site groundwater conditions.
September 1991	WESTON sampled all monitoring wells including W-1 and W-10.
March 1992	WESTON sampled monitoring wells.
May 1992	EKCO removed soil contaminated from the 330-gallon 1,1,1-TCA spill north of the plant.

1.3.1 1984-1987 Investigations

In 1984, with the discovery of 1,1,1-TCA and TCE in the groundwater production wells, EKCO initiated an environmental investigation. During the months of September and October of 1984, seven test borings were drilled by Ohio Drilling, Inc. Four test borings (TH-1-84 through TH-4-84) were drilled only into the shallow overburden, while the remaining three (TH-5-84 through TH-7-84) were drilled through the overburden and into the underlying bedrock. Soil and water samples were collected from all seven locations, and analyses revealed varying levels of VOCs. Two of the shallow test borings (TH-1-84 and TH-2-84) were completed as 1¼-inch inside diameter (i.d.) piezometers (designated as P-1-84 and P-2-84, respectively), while the remaining two were plugged. All three of the open-hole bedrock test holes were completed with 6-inch casing to bedrock and were designated R-1 through R-3. Dedicated pumps were installed into each of these wells. Analysis of samples obtained in 1984 detected VOCs, including TCE, dichloroethene (DCE), and vinyl chloride. An additional bedrock well (R-4) was installed in July, 1985, along the eastern property boundary. No VOCs were detected in samples collected from this well.

Because the then out-of-service production well (W-10) was centrally located on the EKCO property, it was decided that a pump and treat program using this well would be initiated at the facility to control migration of VOCs and to remediate the VOCs detected in groundwater. With the concurrence of OEPA, an air stripper was installed by Ohio Drilling, Inc. in February of 1985 to treat the groundwater recovered by the pumping of well W-10.

On 17 June 1986, FBA was retained by EKCO to develop a preliminary closure plan for the lagoon. The closure plan led to a Phase I screening investigation of the lagoon, which involved the drilling and composite sampling of 12 soil borings. Laboratory analyses of soil samples from this program indicated apparently elevated levels of cadmium, chromium, and lead in soil samples collected within the lagoon and in locations between the lagoon and Newman Creek. No VOCs were detected in any of the soil samples. See the *Groundwater Quality Assessment Plan for EKCO Housewares* (WESTON, March 1988) for a summary review of FBA's analytical results and the locations of these wells and borings.

The Phase I investigation led to a more intensive Phase II soil boring program conducted by FBA in January and February of 1987. The program involved installation of 25 additional soil borings. Four of these soil borings (D-1-27, D-2-30, D-3-17, and D-4-30) were completed as 1½-inch i.d. PVC wells and were used as groundwater monitoring points for the lagoon. Results indicated elevated concentrations of cadmium, chromium, and lead in soils to the maximum depth of the borings. However, this situation is localized in the area near the inlet of the lagoon. Maximum concentrations near the ground surface of 8,400 ppm cadmium, 2,630 ppm chromium, and 19,500 ppm lead were detected.

1.3.2 1987 - Present Investigations

In July 1987, WESTON was retained by EKCO to develop a final closure plan for the lagoon for submittal to OEPA and to develop a groundwater quality assessment program for the entire EKCO facility. In September 1987, WESTON conducted an assessment to collect baseline information and to determine the need for interim corrective measures. This included the following activities:

- Sampling Ohio Water Service Well 4 and all on-site wells (except the out-of-service process water well, W-2) to establish baseline data for each well and collecting well data [e.g., organic vapor analysis (OVA) readings, construction details, depth to water measurements, etc.].
- Surveying all on-site wells.
- Conducting a groundwater utilization survey, which included identifying and locating domestic, commercial and municipal wells within a 1-mile radius of the facility.
- Reviewing plant records and other available documents, which included aerial photographs, tax maps and geologic references.

VOCs were detected in on-site shallow and bedrock groundwater monitoring wells. The major compounds detected were TCE, 1,1,1-TCA, and their breakdown products. The results of the initial investigation are presented in WESTON's *Interim Measures Report*, dated February 1988. While no immediate threat to potable water supplies was identified, WESTON recommended that on-site pumpage be increased, if practical, in order to enhance contaminant recovery and hydraulic control of groundwater underlying the plant.

A groundwater quality assessment program for the EKCO facility was initiated during the summer of 1988. The general purpose of this effort was to address groundwater conditions at the facility proceeding under Section 3008(h) of the Resource Conservation and Recovery Act of 1976, as amended, U.S.C. 6928(h), and as part of the closure plan for the surface impoundment facility, particularly in reference to 40 CFR Section 265.93. The results of this program are presented in the *Groundwater Quality Assessment Report* (WESTON, 1990), which is contained in Appendix A. Field activities for the RFI were initiated at the facility in April 1991. The remaining sections of this report, as described below, discuss the activities, results, and interpretations of the RFI.

Section 2 discusses the environmental setting of the facility, which includes climate, topography and surface drainage, regional geology, regional hydrogeology, local groundwater usage, and demography. Section 3 discusses the RFI field activities conducted at the facility, which consisted of geophysical logging, packer testing, monitor well installation surveying, pump testing, soil and groundwater sampling, and tank tightness testing. Section 4 discusses the results of the RFI field activities and the geology, hydrogeology, and chemical migration at the facility. Sections 5 and 6 discuss the summary and conclusions of the RFI. The references for the RFI are presented in Section 7.

SECTION 2
ENVIRONMENTAL SETTING

2.1 CLIMATE

Information obtained from the Akron/Canton Weather Service Office reveals a precipitation rate of 35.90 inches per year based on records for a 30-year period, 1951 to 1980 inclusive. The mean annual Class A pan evaporation interpreted from a map in the Weather Bureau Technical Paper No. 37 is approximately 40 inches per year.

2.2 TOPOGRAPHY AND SURFACE DRAINAGE

The EKCO facility is approximately triangular in shape. It is bounded on two sides by railroad tracks and on the third by Newman Creek. Surface water runoff at the facility discharges to Newman Creek by two pathways. Surface runoff from the northern part of the facility flows directly into Newman Creek. Surface discharge throughout the remainder of the facility is routed through the storm sewer system, which discharges through Outfall 001 into Newman Creek. A site plan showing the storm sewer system is included in Figure 2-1. The edge of the facility is located within the 100-year floodplain of Newman Creek, as shown in Figure 2-2.

2.3 REGIONAL GEOLOGY

The geology of Stark County, Ohio, is characterized by unconsolidated glacial drift sediments deposited during the Pleistocene epoch in unconformable contact with underlying Pennsylvanian-aged sedimentary rocks.

The drift deposits of Stark County originated predominately from the advance of glacial lobes during the Wisconsinan stage (White, 1982). The drift consists of the interbedding of two principal types of deposits distinguished by two distinct textures. Till deposits are ice-laid material; they are an unsorted mixture of clay, silt, sand, pebbles, cobbles, and boulders.

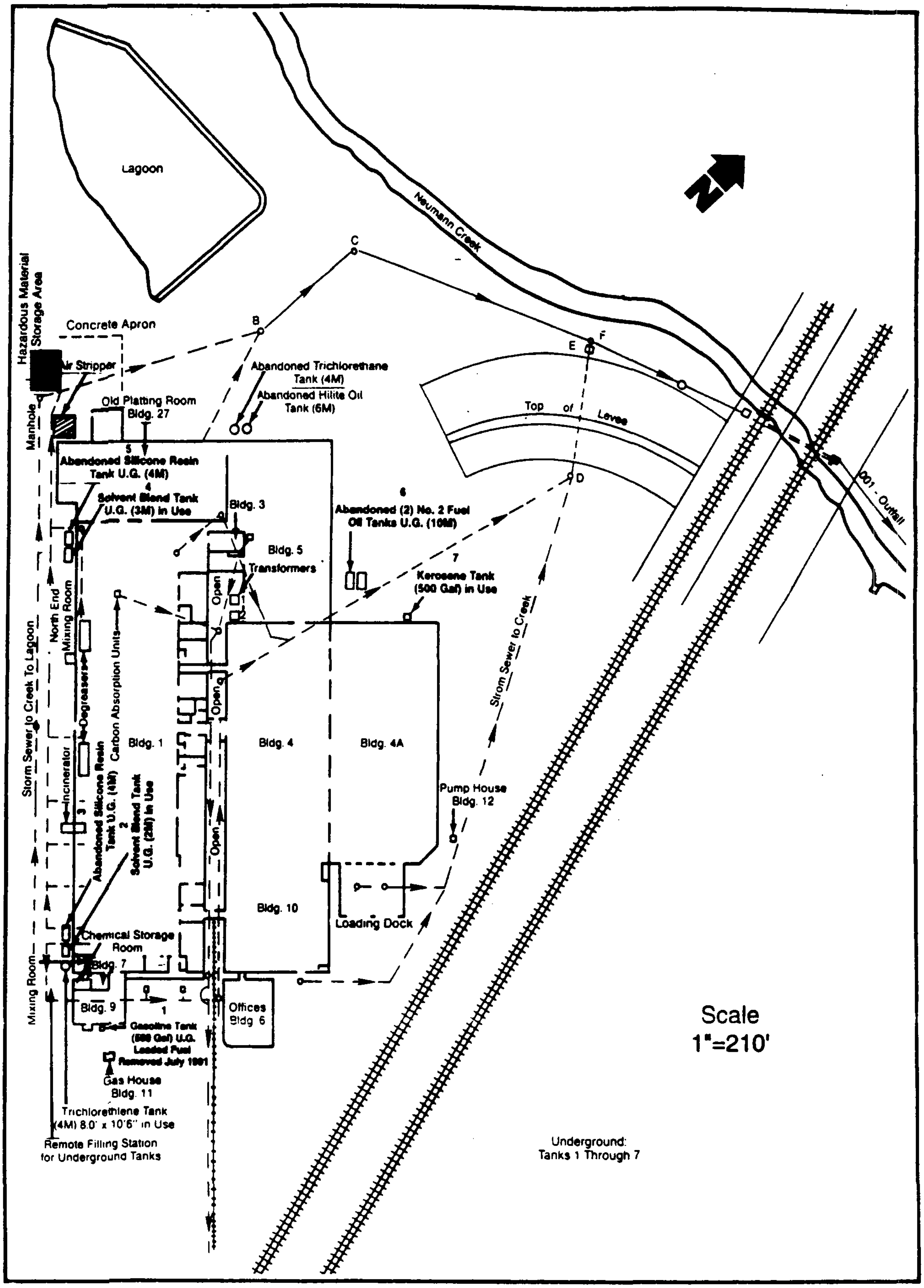
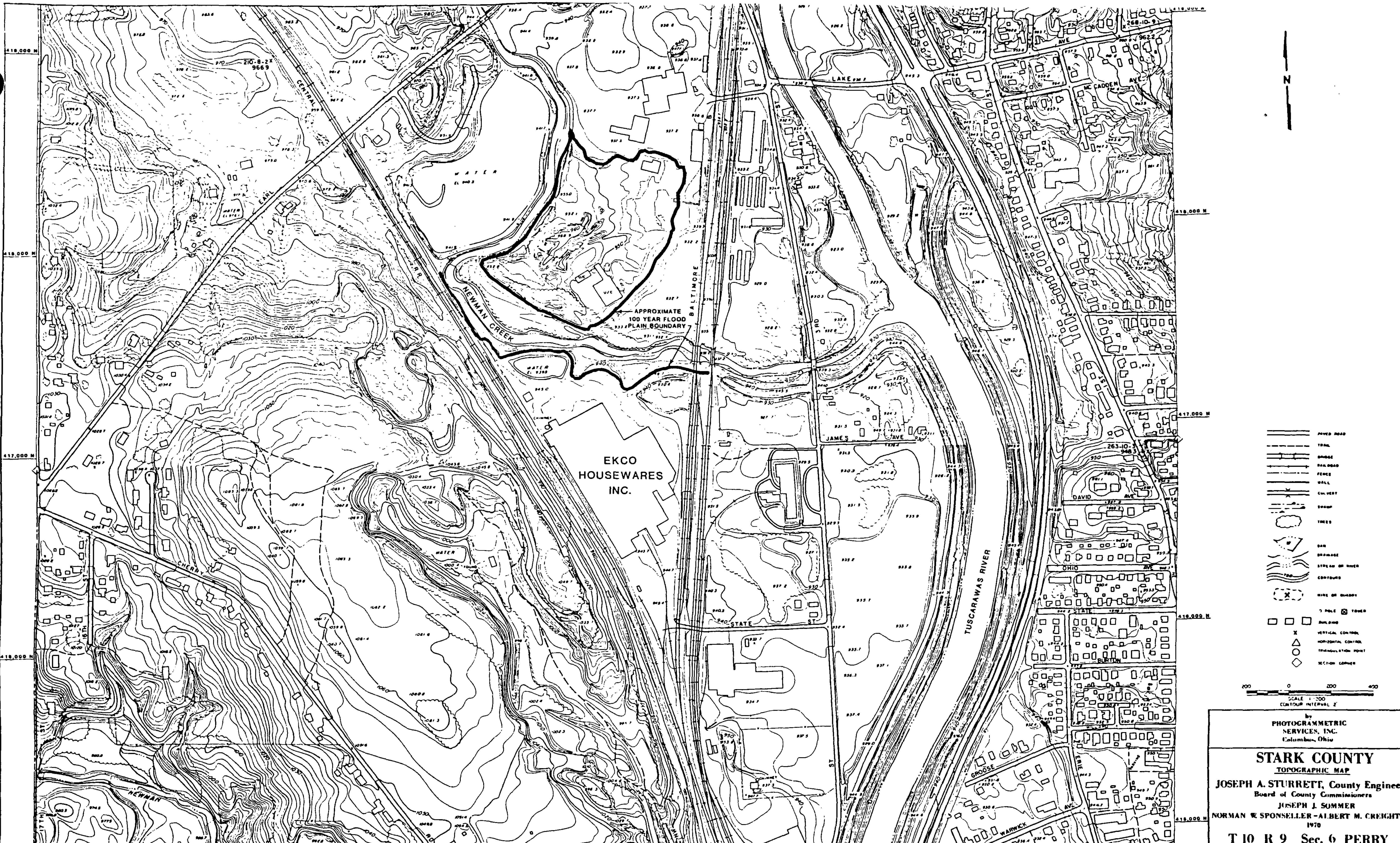


FIGURE 2-1 FACILITY DESCRIPTION AND LOCATION
EKCO HOUSEWARES, INC., MASSILLON, OHIO



EKCO HOUSEWARES INC.
MASSILLON, OHIO

WESTON

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

RCRA PART B PERMIT APPLICATION
DECEMBER 1988

DRAWN P. WHITEMAN	DATE 12-7-88	FIGURE 2-2
SCALE AS SHOWN	W.O. NO. 2994-02-03	

Outwash deposits are water-laid material deposited in front of the advancing or retreating ice lobe; they are moderately well-sorted mixtures of sand and gravel. The glacial drift deposits range in thickness between 25 ft in areas of bedrock highs to 300 ft in areas of glacially eroded valleys (White, 1982).

Underlying the drift deposits is a series of bedrock shales, sandstones, and argillaceous sandstones belonging to the Pottsville group. This bedrock group dips generally to the southeast at approximately 20 to 40 ft per mile (Cross and Hedges, 1959). The sedimentary rocks of the Pottsville originated from the erosion of the Appalachian mountain chain to the east during the Pennsylvanian period. The Pleistocene glacial lobes subsequently eroded into the Pennsylvania-aged bedrock in Stark County, producing the characteristic bedrock topography of U-shaped valleys and flat uplands.

Two important water-producing sandstones of the Pottsville group are exposed in the Akron-Canton area: the Sharon and Massillon sandstones. The Sharon consists of a poorly cemented, pure quartz sandstone with intermittent lenses of quartz pebbles. Locally, the Sharon can be up to 200 ft in thickness (Hansen, 1989). The Massillon is similar in appearance to the Sharon except that it is less pure and contains fewer pebbles (Hansen, 1989). Both sandstones are quarried for building stone because of their high silica content.

2.4 REGIONAL HYDROGEOLOGY

2.4.1 Unconsolidated Material

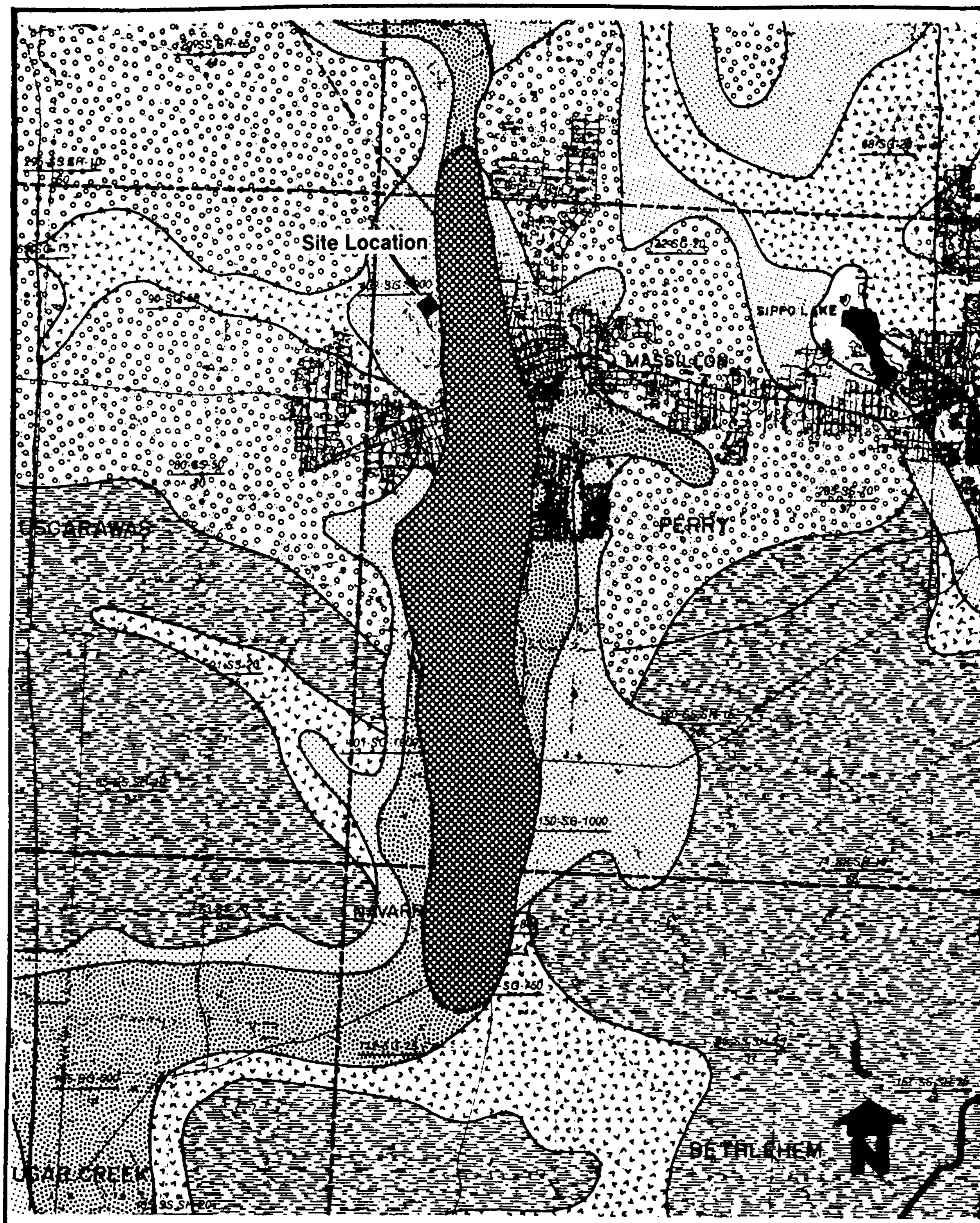
The western portion of Stark County lies within the Middle Tuscarawas River Basin. The units capable of providing sufficient quantities of groundwater to domestic, commercial, and municipal wells underlying this basin include the unconsolidated deposits of sand and gravel and the consolidated layers of sandstone, shale, limestone, and coal. Yields may range from less than 1 gallon per minute (gpm) from clay and shale deposits to more than 1,000 gpm from thick, unconsolidated, permeable sand and gravel deposits (Schmidt, 1962). The generalized stratigraphic table (Table 2-1) briefly describes the physical and water-producing characteristics of the units within the Tuscarawas River Basin. Figure 2-3 illustrates the

Table 2-1

Generalized Stratigraphic Sequence in Middle Tuscarawas River Basin

System or Series	Group or Formation	Character of Material	Water-Bearing Characteristics
Quaternary		Clay, silt and alluvium deposited on the flood plains of the principal valleys.	Generally a poor source of groundwater, because of limited thickness and absence of coarse materials.
Quaternary Pleistocene		Interbedded and interlensing layers of sand, gravel, and clay deposited in the buried valleys by glacial meltwaters.	Quantity of available water depends on character of material and source of recharge. Properly developed wells yield in excess of 1,000 gpm.
		Thick layers of silt and clay interbedded with relatively thin lenses of sand and gravel.	Drilled wells developed in the sand and gravel yield 5 to 15 gpm.
Pennsylvanian	Pottsville	Alternating layers of shale, sandstone, limestone, and coal.	Yields sufficient water for farm and domestic needs.
		Thin to thick, coarse-grained sandstone.	Domestic, farm, and industrial supplies are readily available. Yields of as much as 500 gpm reported; however, regional yield seldom exceeds 15 gpm.
Mississippian		Alternating layers of sandstone and shale.	Farm and domestic supplies are readily developed. If thick shale formations predominate, meager groundwater supplies are developed.

Source: Schmidt, 1962.



Legend

= Permeable Sand and Gravel Deposits in Deep Buried Valleys. Can Yield More Than 500 gpm.

= Valley Fill Containing Sand and Gravel Deposits of Limited Thickness and Extent. Can Yield 10-30 gpm.

= Permeable Sand and Gravel Deposits Not Traversed by Major Streams. Can Yield 100-500 gpm.

= Interbedded and Interlensing Sand, Gravel, Silt and Clay. Can Yield 25-100 gpm.

= Sandstones of the Pottsville Group. Can Yield 25-100 gpm.

= Sandstones and Sandy Shales. Can Yield 10-30 gpm.

Scale in Miles

0 1 2 3 4

(Source: **Groundwater Resources of Stark County,** Alfred C. Walker, Ohio Department of Natural Resources.)

FIGURE 2-3 GROUNDWATER RESOURCES OF MASSILLON, OHIO

availability and yield of groundwater in the western portion of Stark County. The outwash deposits beneath the flood plain of the Tuscarawas River have the greatest potential for the development of large groundwater supplies in this basin. Yields from properly developed wells in this unit range from 500 to more than 3,000 gpm. The majority of these wells are developed at depths of less than 160 ft (Schmidt, 1962).

Many of the tributaries to the Tuscarawas River are also underlain by thick outwash deposits composed of predominantly clay interbedded with layers of fine sand and gravel. Portions of these tributary valleys are filled with as much as 270 ft of unconsolidated deposits (Schmidt, 1962). But, because of the predominance of clay, the average yield of these deposits is less than 25 gpm, and water wells are typically drilled through these unconsolidated deposits to the underlying bedrock.

2.4.2 Bedrock

The bedrock underlying the glacial deposits in the basin consists of interbedded, thin to thick layers of sandstone, shale, coal and occasional limestone. All of these are part of the Pottsville group of Pennsylvanian age. The average domestic well is 170 ft in depth and yields about 8 gpm. Yields of commercial and municipal wells developed in the sandstone units of the lower Pottsville formation are reported to range from 25 to 100 gpm for short periods of intermittent pumping (Walker, 1979).

2.5 LOCAL GROUNDWATER USAGE

2.5.1 Ohio Water Service Wells

Currently, the Ohio Water Service Company (OWS) has seven active production wells (OWS-1, -2, -3, -5, -7, -8 and -9), and one out-of-service well (OWS-4), which was abandoned and subsequently converted into an observation well. Wells OWS-1, -2, and -3 are located approximately 2,000 ft northeast of the facility and 150 to 200 ft east of the Tuscarawas River (Figure 2-4). OWS-5 is located approximately 4,200 ft north of the facility and 100 ft west of the Tuscarawas River. OWS-7, -8, and -9 all lie approximately 1.6 miles north of the facility and are approximately 100 ft west of the Tuscarawas River. The abandoned well, OWS-4, is currently being used as a monitoring well and is located 1,000 ft east of the facility and approximately 500 ft west of the Tuscarawas River.

The OWS well field pumps approximately 7.5 million gallons per day from the seven active production wells. Individual wells are pumped at varying rates to maintain this production. Only three wells are normally run at any one time. When running, the rates at which OWS-1, -2, -3, -5, -7, -8, and -9 are pumped are approximately 2,800, 1,300, 600, 2,450, 2,100, 2,100, and 2,000 gpm, respectively. All of the OWS wells are reported to have been constructed with 50-ft screens and to have reached total depths of 150 to 160 ft, with the exception of OWS-5, which was reportedly screened in the unconsolidated material that lies on top of the bedrock.

2.5.2 EKCO Production/Recovery Wells

There are currently two on-site production wells (W-1 and W-10) being used as groundwater recovery wells. Well W-1 is located near the southern corner of the plant building, and well W-10 is about 800 ft north of W-1 and inside the plant building (Figure 2-5). The log for well W-1 shows a total of approximately 116 ft of shale interbedded with 84 ft of sandstone. The thickness of sandstone beds reported in the log vary from a minimum of 12 to a maximum of 49 ft. Shale beds vary from 13 to 46 ft in thickness. Well W-1 is completed as an open hole well in bedrock to a total depth of 225 ft. Shale was encountered at 25 ft, followed by a series of interbedded sandstones and shales. Construction details for well W-10 are unavailable at this time, but it is believed to be cased to bedrock (approximately 60 ft) and completed as an open hole well in bedrock to a similar total depth to that of well W-1.

The pump and treat groundwater recovery system commenced operation in February 1986, with the concurrence of OEPA. When system operation was initiated, well W-1 pumped at 245 gpm and W-10 pumped at 140 gpm. Available records indicate that these pumping rates were fairly constant through the first 2 years of the pump and treat program. During this time, flow rates reportedly varied about 10 to 15 gpm. In April 1988, the pumping rate of well W-10 was increased to 255 gpm, while the pumping rate of well W-1 remained fairly constant at about 245 gpm. Records indicate that the pumping rate of well W-10 was increased to 305 gpm in May of 1988, to 330 gpm in August of 1988, then to 375 gpm in September of 1988, while the rate of W-1 remained constant at 245 gpm. In December of 1988, the pumping rate of well W-10 was 345 gpm and W-1 was 245 gpm. A summary of pumping rates and VOC levels in wells W-1 and W-10 during 1990 and 1991 is shown in Table 2-2. Total VOC levels in the recovered groundwater were 18,000 μg/L in 1986. By 1987, total VOC levels had dropped to 8,000 μg/L. During the period 1990, 1991, and 1992, total VOC levels were 1,426 μg/L, 1,278 μg/L, and 1,459 μg/L, respectively.

The recovered groundwater is pumped to an air stripper to remove VOCs. The treated groundwater is subsequently discharged through an NPDES-permitted outfall to Newman Creek.

A comparison of VOC levels at the air stripper discharge and at the outfall indicate the VOC levels actually increase at the discharge point. The VOC results are presented in Table 2-3. An investigation of the sewer line integrity was performed in June 1992 by PLS International. A layout of the storm sewer system is shown in Figure 2-1. This investigation showed portions of the sewer that displayed substantial deterioration. The sections of the piping from Manhole A to Manhole B and from Manhole B to Manhole C, which conveys the discharged water from the air stripper, showed evidence of fractures, compression, and offsets. Failure of the piping may explain the increase in VOC levels from the air stripper discharge to the outfall. EKCO replaced the leaking piping between Manhole A and Manhole B in September 1992. Since replacement of the piping, VOC levels in the outfall have dropped to between 14 μg/L and 47 μg/L.

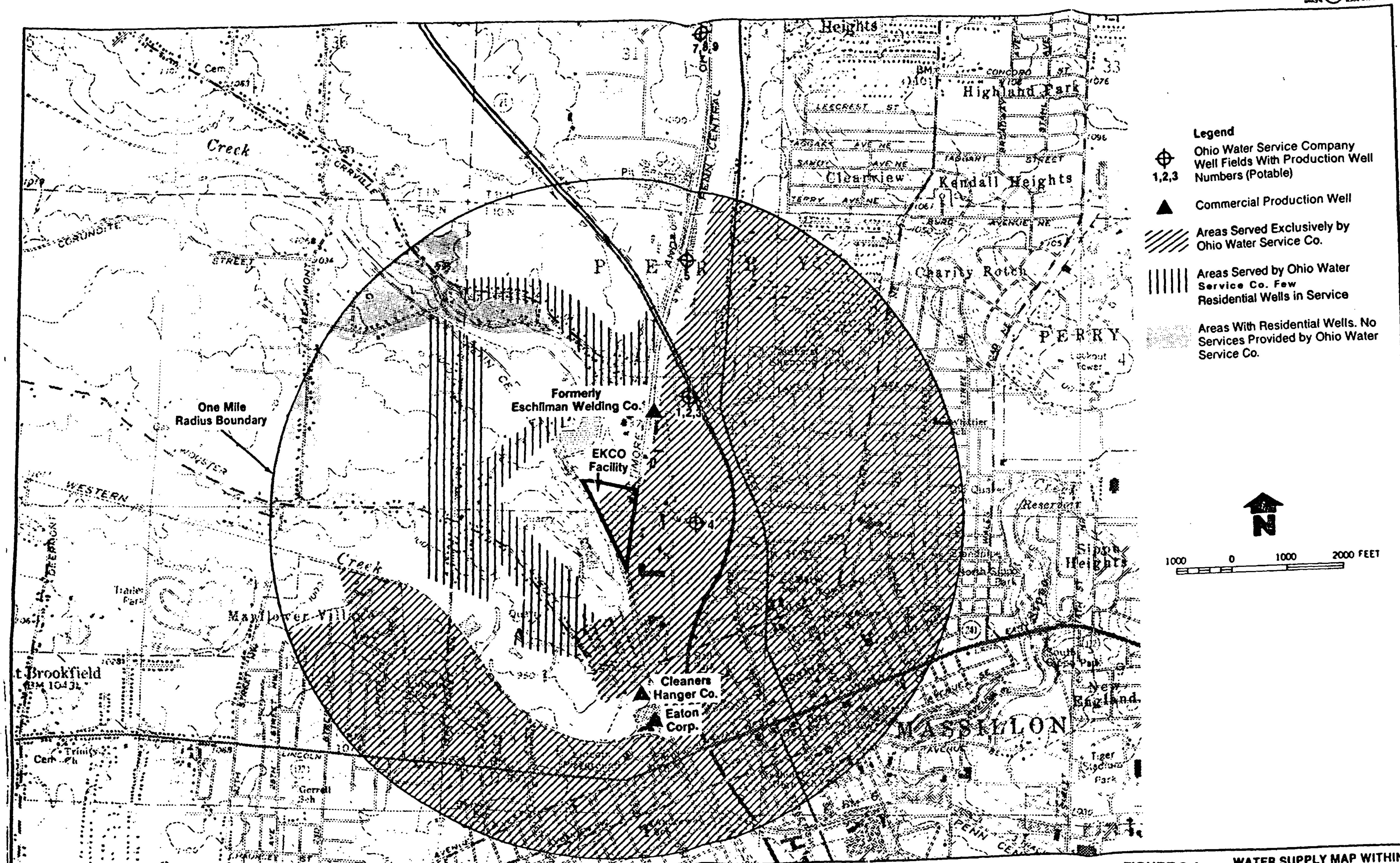


FIGURE 2-4 WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY

(Ref. 7.5 Minute Massillon Quad. Ohio, 1978)

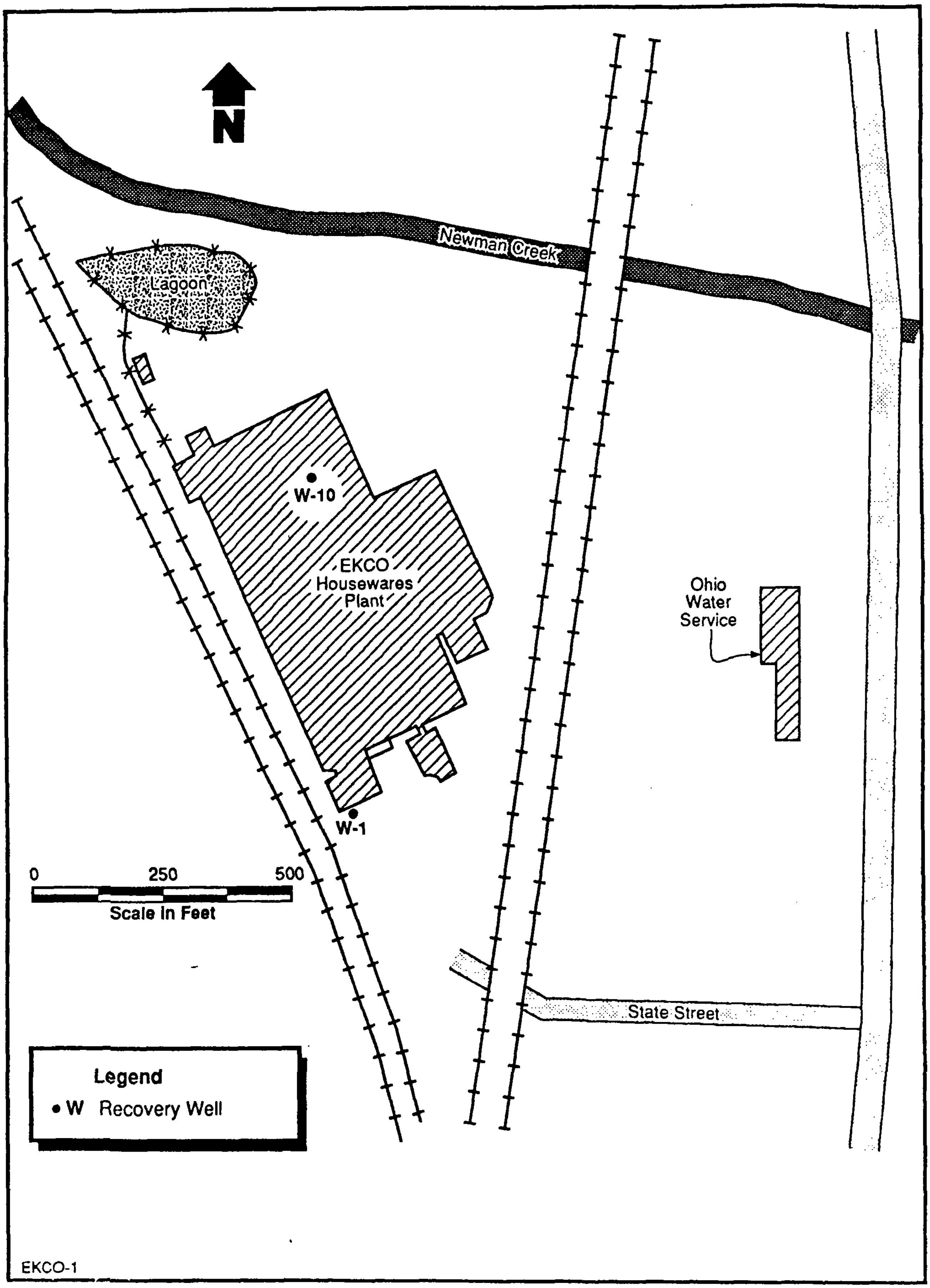


FIGURE 2-5 EKCO FACILITY RECOVERY WELLS

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Table 2-2

Pumping Rates and Total VOCs for Recovery Wells W-1 and W-10

W-1 Well Samples	Pumping Rate (gpm)	Water Treated (gallon)	Total VOCs (µg/L)	W-10 Well Samples	Pumping Rate (gpm)	Water Treated (gallon)	Total VOC (µg/L)
2/1/90	250	9,595,000	142	2/1/90	360	13,996,200	1923
3/5/90	260	11,648,000	117	3/5/90	360	16,368,200	2173
4/3/90	260	10,847,000	109	4/3/90	350	14,577,000	1832
5/2/90	260	10,799,000	131	5/2/90	340	14,133,099	2849
6/4/90	255	12,310,000	146	6/4/90	330	16,000,700	2597
7/6/90	265	11,946,000	173	7/6/90	330	15,051,200	2540
8/3/90	260	10,541,000	173	8/3/90	320	13,180,600	2378
9/5/90	260	12,319,000	158	9/5/90	325	13,845,800	2140
10/2/90	260	10,020,000	150	10/2/90	340	12,895,300	2163
11/1/90	260	11,106,000	132	11/1/90	350	14,958,000	2776
12/4/90	260	12,120,000	150	12/4/90	340	16,588,600	3069
1/7/91	260	12,470,000	180	1/7/91	335	16,720,500	2850
2/1/91	260	9,342,000	173	2/1/91	340	12,085,300	2153
3/8/91	255	12,871,000	179	3/8/91	335	16,758,399	2286
4/1/91	250	8,634,000	175	4/1/91	325	11,265,200	1873
5/1/91	210	9,789,000	181	5/1/91	320	13,868,800	1610
6/4/91	210	10,055,000	264	6/4/91	310	15,440,399	2384
7/1/91	205	3,211,920	303	7/1/91	260	4,938,500	2436
8/1/91	200	9,156,000	248	8/1/91	265	11,861,600	1965
9/3/91	210	9,767,000	302	9/3/91	270	12,835,400	2182
10/3/91	200	8,452,000	233	10/3/91	280	11,722,800	1876
11/5/91	205	9,507,000	208	11/5/91	265	12,592,500	1498
12/13/91	205	10,847,000	256	12/13/91	265	14,287,000	1554
1/6/92	280	2,882,000	-	1/6/92	280	9,372,000	1594
2/7/92	-	-	-	2/7/92	285	12,845,900	1744
3/6/92	205	5,313,600	4726	3/6/92	270	4,729,100	3928
4/13/92	220	12,038,400	138	4/13/92	240	10,656,900	827

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Table 2-2

Pumping Rates and Total VOCs for Recovery Wells W-1 and W-10 (Continued)

W-1 Well Samples	Pumping Rate (gpm)	Water Treated (gallon)	Total VOCs (µg/L)	W-10 Well Samples	Pumping Rate (gpm)	Water Treated (gallon)	Total VOC (µg/L)
5/5/92	220	6,857,000	174	5/5/92	235	7,570,000	1418
6/2/92	210	8,584,000	218	6/2/92	265	10,566,300	1206
7/1/92	220	8,757,000	71	7/1/92	270	10,848,400	1470

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Table 2-3

Air Stripper Discharge

Date	Pumping Rate (gpm)	Total VOCs at Air Stripper Discharge (ug/L)	Total VOCs at Outfall (ug/L)
8-1-91	465	19	28
9-3-91	480	250	34
10-3-91	480	6	340
11-5-91	470	4	190
12-13-91	470	5	67
1-6-92	280	ND	28
2-7-92	285	167	2319
3-6-92	475	20	760
4-13-92	460	9	490
5-5-92	455	ND	350
6-2-92	495	ND	275
7-1-92	490	ND	398

2.5.3 Private Wells

In addition to the OWS wells, approximately 50 domestic wells and three commercial wells are located within a 1-mile radius of the facility. No information is available on the depth of the domestic wells. The average depth of commercial wells is 225 ft. The locations of these wells are shown in Figure 2-4.

2.6 DEMOGRAPHY

Based on the estimated 1990 census, 62,000 people live within 4 miles of the center of the EKCO facility. The surrounding land is largely industrial and urbanized. The most densely settled areas are located to the east of the site.

SECTION 3
RFI FIELD ACTIVITIES

This section describes the activities conducted by WESTON during the RFI field investigation at EKCO from April 1991 to March 1992. These activities were conducted for the purpose of evaluating the hydrogeological and geochemical conditions as they pertain to the quality of the soil and the groundwater at this site. These RFI activities were designed based on the results of the *Groundwater Quality Assessment Report* and the RFI guidance contained in the EPA RFI guidance document. The sampling and testing procedures used for the RFI activities are detailed in the RFI Work Plan and are discussed in general in this section. These activities included the following:

- Geophysical logging
- Packer testing
- Pump testing
- Soil sampling
- Groundwater sampling

The results and interpretation of the RFI activities are presented in Section 4 of this report.

3.1 GEOPHYSICAL LOGGING

Borehole geophysical logs were run in bedrock wells R-1, R-2, and R-4 at the EKCO facility on 15 April 1991, prior to performance of packer testing. Geophysical logging was performed by a subcontractor, Earth Data, Inc., and was supervised in the field by WESTON geologists. The objectives of the geophysical logging program were to:

- Identify any potential problem areas (e.g., obstructions, washouts, or fill) in the boreholes that could prevent the setting and removal of the packer tools across potential test zones.
- Identify the presence of smooth borehole sections for the proper seating of the inflatable packers.

- Correlate the lithology among the three bedrock wells (R-1, R-2, and R-4) along an east-west line of section.

- Determine the depth and condition of the casing in each well.

The following suite of geophysical logs was run in wells R-1 and R-2:

- Three arm caliper (caliper).
- Natural gamma (gamma).
- Resistivity.
- Spontaneous potential (SP).

All of the above logs, with the exception of the caliper log, were also run in well R-4. No packer testing was to be conducted in this well, and only lithologic information was needed.

Each logging run was referenced to the top of the surveyed steel casing at each well so that depths could be converted to feet above mean sea level (MSL). A brief description of each log and the procedures followed in running each log are summarized below.

3.1.1 Caliper Log

The caliper log provides a continuous record of the average diameter, in inches, of a drillhole. Mechanical arms or feelers are maintained against the borehole wall by springs, which allow the arms to open and close with changes in borehole size. The caliper tool was run to the bottom of each well, the arms were opened, and the log was recorded while moving the caliper tool up the borehole at a constant logging speed of 20 ft per minute (fpm). The caliper log was used to locate smooth or irregular borehole intervals and to check the general condition of each well.

3.1.2 Natural Gamma Log

The gamma log provides a continuous record of the amount of natural gamma radiation emitted by the formations penetrated by a borehole. In general, the gamma activities of clay-bearing sediments and rocks (i.e., clays and shales) are much higher than those of quartz sands or sandstones. The gamma ray probe detects gamma radiation through the use of a sodium iodide crystal and a scintillation counter. The greater the counting rate, the more events the gamma detector is measuring, which, in turn, corresponds to a higher clay content of the surrounding strata. The gamma log does not have a unique response to lithology; however, response is generally consistent within a single geohydrologic environment. The gamma tool was run recording from the bottom to the top of each well at a constant logging speed of 20 fpm. The gamma logs were used to identify the various lithologic units beneath the facility where the relative gamma response decreased from the fine-grained shales or siltstones to the coarse-grained sandstones.

3.1.3 Resistivity Log

The resistivity log measures the electrical resistance (in ohms) of the earth materials lying within the well between two electrodes on the probe. Increases in formation resistance produce corresponding increases in resistivity on the log. In general, the resistivity log response in resistive rocks (sandstones) and conductive rocks (shales) provides a mirror image of the gamma log under suitable conditions. Because a constant electric current is generated between the two in-hole electrodes on the resistivity tool, the log requires a borehole fluid to conduct the current. As a result, the resistivity tool was run from the bottom to the top of the fluid column in each well at a constant logging speed of 20 fpm. The resistivity logs were used to correlate lithologic changes and shale content in the uncased, fluid-filled portions of each well.

3.1.4 Spontaneous Potential Log

The SP log is a record of potentials or voltages that develop between shale and sandstone contacts when salinity differences exist between the borehole fluid and the formation water. These logs are widely used in the oil fields to provide information on lithology and salinity of interstitial water but are not universally applicable in fresh-water environments. Salinity differences did not exist in the EKCO wells and, therefore, no interpretation of the SP logs was possible. The log was part of the combination electric tool that housed the resistance log described previously.

3.2 PACKER TESTING

Packer tests were performed in April 1991. The packer tests were conducted by a subcontractor, Earth Data, Inc., and were supervised in the field by a WESTON geologist. The activities conducted at the facility included packer testing, groundwater sampling, and continuous water level recording. The objectives of the packer test investigation were to evaluate the:

- Vertical profile of groundwater quality and head distributions within the borehole between water bearing units.
- Extent of vertical hydraulic interconnection between alternating sandstone and shale beds, and the indicated degree of lateral hydraulic interconnection between the tested wells (R-1 and R-2) and the nearby observation wells (R-4, R-5, I-2, and L-2).
- Specific capacities of the primary water-bearing units within each well.
- Lateral lithologic correlation of shale and sandstone beds encountered and logged in wells R-1, R-2 and R-4 to better understand the geology and groundwater migration at the facility.
- Integrity of the casing seat on well R-2.

Packer tests were conducted on two bedrock monitor wells at the facility, R-1 and R-2. Prior to performing the packer tests, caliper and gamma ray geophysical logging was done on wells R-1, R-2, and R-4 in order to obtain information necessary for selecting packer intervals and to assist in evaluation of the geology at the facility. Water levels were continuously recorded in six wells (R-1, R-2, R-4, R-5, I-2, and L-2) during the packer testing activities. The locations of these wells are shown on Figure 3-1. The packer testing methodology is presented in Appendix B.

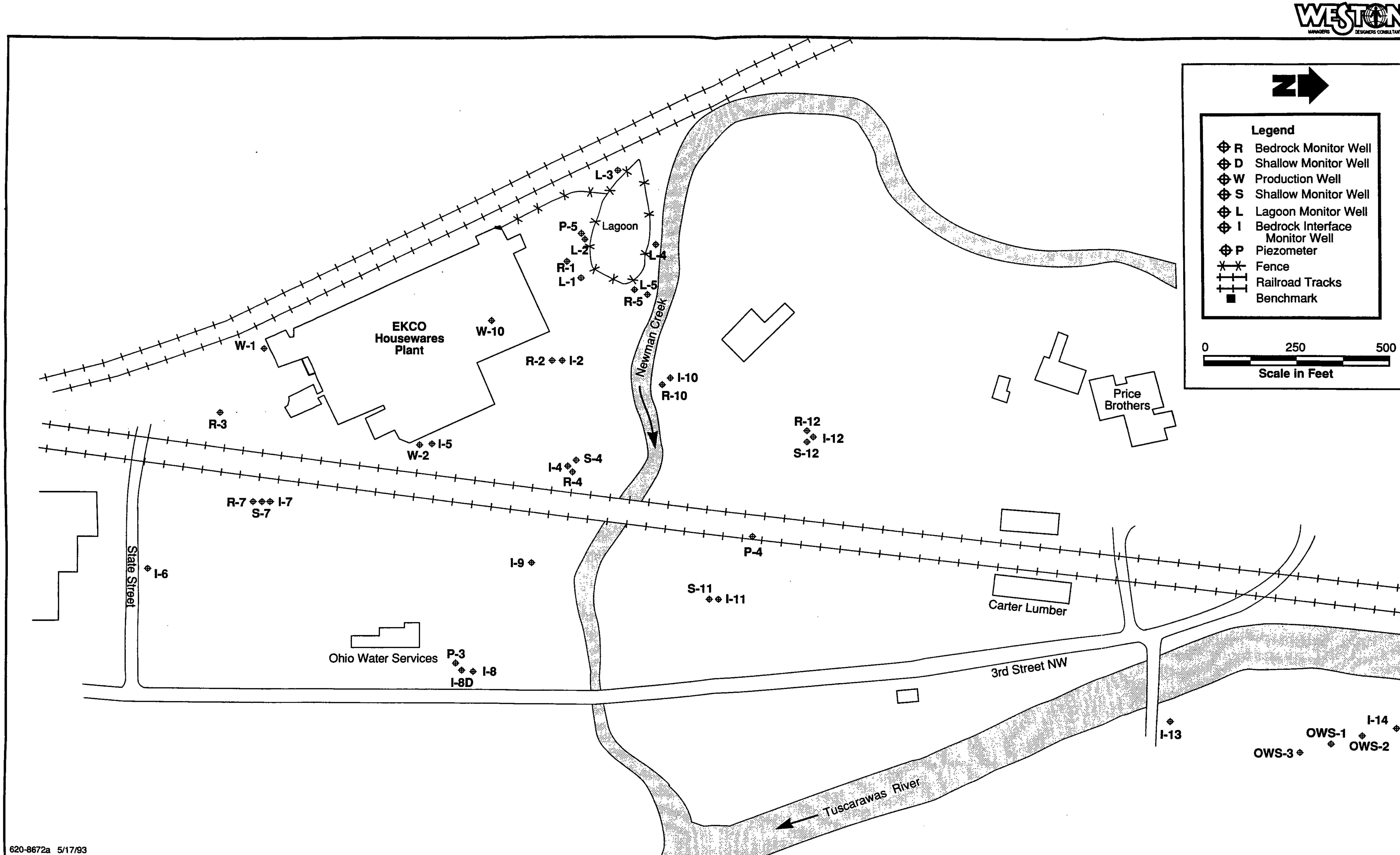

FIGURE 3-1 MONITOR WELL LOCATION MAP

3.3 MONITOR WELL INSTALLATION

During the months of June, July, and August 1991, 13 additional monitor wells were installed at and around the EKCO facility. The 13 wells consisted of three shallow wells, designated S-4, -11, and -12; seven bedrock-interface wells, designated I-8D, -9, -10, -11, -12, -13, and -14; and three bedrock wells, designated R-7, -10, and -12. The locations of these new wells and all other wells are shown in Figure 3-1.

Three categories of wells were installed during this field effort: shallow wells ("S" wells), bedrock-interface wells ("I" wells), and bedrock wells ("R" wells). The general construction of these wells is shown in Figure 3-2. All of these new wells were constructed entirely with 4-inch type No. 304 stainless steel riser pipe and 0.010-inch slot 4-inch wound-wire type No. 304 stainless steel screen. Depending on conditions, either a No. 2 sand pack or a natural sand pack was extended at least 2 ft above the screened interval, and at least 2 ft of bentonite pellets or bentonite slurry was emplaced above the sand pack. A 2 by 2-ft cement pad and a locked protective steel casing was installed for each well. The monitor well installation methodology is presented in Appendix C.

The monitoring wells were installed to characterize the hydrogeology and the groundwater quality in the area of the EKCO facility. All of the shallow wells were installed into the first encountered water-bearing zone, and they are located adjacent to deeper wells to evaluate vertical groundwater gradients and shallow groundwater quality. There were two types of I-wells installed. Wells I-8D through I-12 were installed in the closest water-producing zone to the overburden/bedrock interface. Well I-8D was originally planned to be a bedrock well but, when no bedrock was encountered after drilling to a depth of 255-ft, it was decided to complete the well on top of the thick silt and clay layer at a depth of 177 ft. The size of the drilling rig and the drive casing being used prevented drilling to a deeper depth. The other two I-wells (I-13 and I-14) were installed at a total depth of 150 ft in order to monitor the same interval of sediments from which the adjacent OWS wells (OWS-1, -2 and -3) are pumping. The three bedrock wells (R-7, -10, and -12) were screened in the first encountered productive water-bearing zone in competent sandstone bedrock. Well

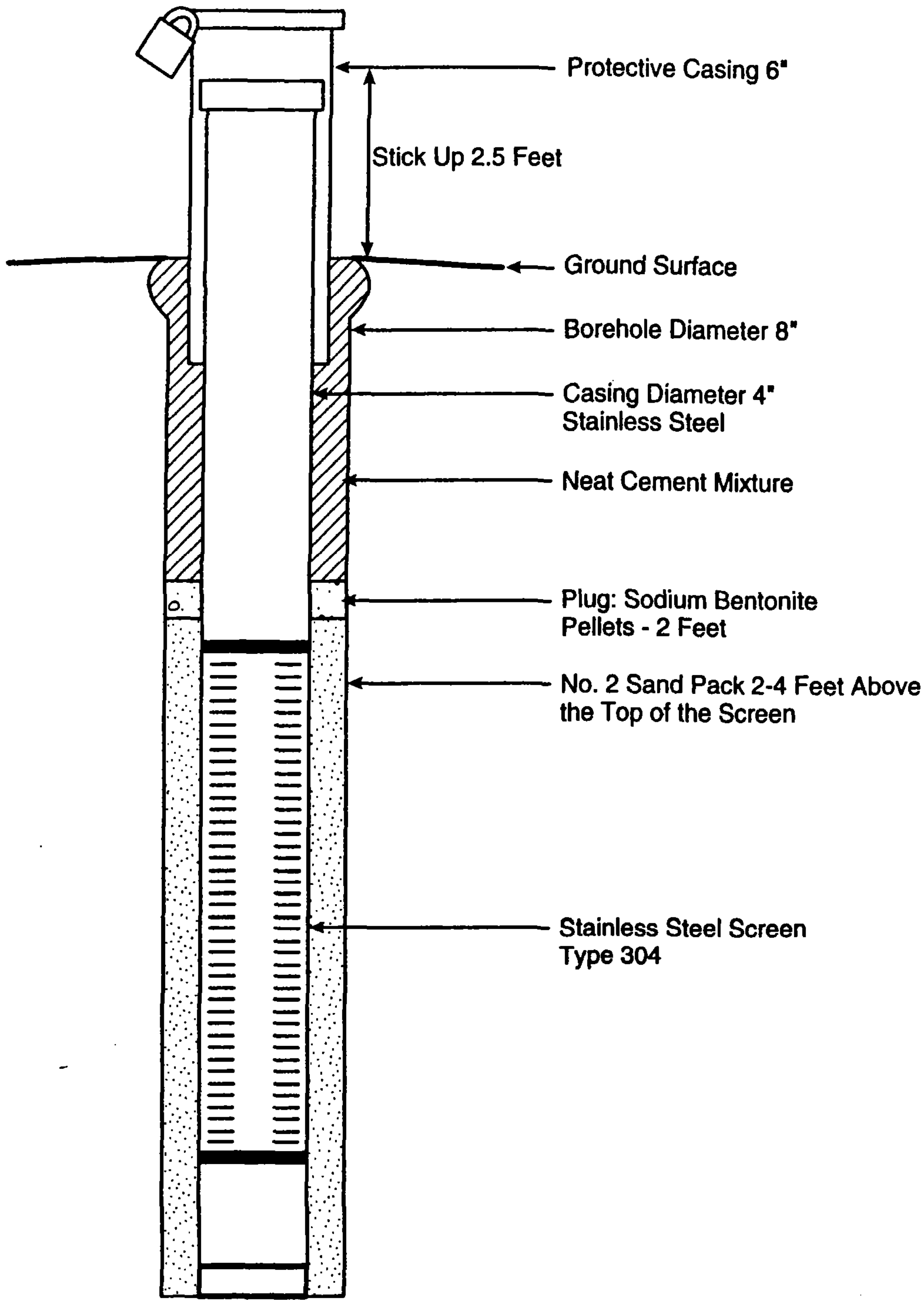

FIGURE 3-2 TYPICAL SPECIFICATIONS FOR MONITOR WELL COMPLETION

construction diagrams and geologic logs are shown in Appendix D. All of the wells were developed by pumping or bailing the wells until at least five well volumes had been removed and the water was relatively sediment-free.

Five of the wells are on Price Brothers' property north of the facility; two of the wells are located on Carter Lumber's property northeast of the facility; and four of the wells are located on OWS property northeast and east of the facility. Written approval to install the monitor wells was requested and received from all three of these property owners and also from EKCO Housewares prior to installing the wells. A utility clearance was performed through the Ohio Utility Clearance Protection Service, and a utility clearance was also received from the property owners prior to installing the wells.

Bowser-Morner, Inc. installed the wells under subcontract to WESTON, and their activities were supervised in the field by a WESTON geologist. A cable tool drilling rig was used because it has been the most successful method of drilling in the deep glacial sand and gravel material found in the area of the facility. Cable tool drilling also allows for continuous collection of drilling samples from the bailer, and the drive-casing, which is driven ahead of the drilling bit during cable tool drilling, prevents the downward migration of potentially contaminated shallow water to a deeper aquifer.

3.4 SURVEYING

Surveying of monitor wells was accomplished by Buckeye Surveying, Inc., under subcontract to WESTON. Surveying was conducted in September of 1991. Buckeye surveyed the vertical elevation at three locations on each well: the top of the inner casing, the top of the outer casing, and ground level. A survey mark was marked on each well at the point where the survey was done for the inner casing. The horizontal location of each well was also surveyed. Buckeye surveyed all of the other wells on-site in August 1988, so they were able to tie the new wells into the survey loop they established in 1988. The survey was tied into a U.S. Geological Survey (USGS) benchmark, which is located on the well location map shown in Figure 3-1. The base map generated from the survey effort was used to generate all of the site maps used in this report. A summary of the surveying results is shown in Table 3-1. All of the wells were labeled with their appropriate well numbers on the outside of the casing.

3.5 PUMP TESTING

Five short term constant rate pumping tests were conducted on monitor wells constructed in overburden wells at and near the EKCO facility during September 1991. The tests were conducted on three interface wells (I-2, I-11, and I-13) and two shallow wells (S-7 and S-11). The purpose of the pumping tests was to evaluate the transmissivity of the overburden materials and hydraulic conductivity in the area of the facility. Data from well installation and development, and from short-term step tests, were used to select an appropriate pumping rate for each test.

Prior to starting each pumping test, a short-term step test was conducted followed by continual background monitoring overnight. The tests were originally scheduled for a duration of 8 hours, but two of the tests (S-11 and I-2) were reduced to only 2 and 3 hours, respectively, because of problems with the generator and discharge line. Water levels were continuously recorded with electronic transducers in the tested well and nearby observation wells to monitor background conditions and the effects of the pumping. After terminating the drawdown tests, recovery was monitored until the wells recovered to within at least 90% of their static levels. The discharge water from the pumping tests was containerized in a tanker truck and then pumped through the existing air stripper. The pump testing methodology is presented in Appendix E.

3.6 SOIL SAMPLING

The groundwater quality assessment program identified four potential source areas: the active tank area at the southwestern end of the plant; the abandoned tank area at the northern end of the plant near well D-4-30; the sump at well W-10 inside the plant; and

Table 3-1

Elevation and Location Survey Results

Well	North	East	Top of Inner Casing	Top of Outer Casing	Ground	Others
D-1-27	6065.338	5289.507	948.09	948.26	946.2	NA
D-2-30	6096.099	5415.059	946.16	946.31	944.1	NA
D-3-17	6215.142	5450.022	936.81	936.99	934.2	NA
D-4-30	5946.105	5419.603	NA	949.72	947.4	NA
1-2	6008.795	5636.674	946.40	946.69	944.0	NA
1-4	6036.420	5938.350	933.23	933.37	932.3	NA
1-5	5649.680	5878.506	946.13	946.13	943.8	NA
1-6	4880.413	6247.524	940.62	940.62	937.9	NA
1-7	5228.139	6052.270	940.04	941.06	939.4	NA
1-8	5738.442	6504.282	931.51	933.23	931.1	NA
L-1	680.781	5409.180	946.33	946.77	944.2	NA
L-2	6068.230	5295.739	947.57	948.08	946.2	NA
L-3	6157-633	5113.546	946.91	947.37	946.0	NA
L-4	6258.417	5306.089	938.22	938.70	935.9	929.40
P-1-84	5945.111	5444.624	NA	NA	946.8	948.66
P-2-84	6102.295	5430.822	NA	NA	943.2	945.84
P-3	5740.736	6515.588	933.68	933.87	930.9	NA
P-4	6589.462	6120.430	938.49	938.63	936.7	NA
P-5	6062.376	5284.706	948.43	948.60	946.2	NA
R-1	6020.037	5357.662	NA	946.91	946.0	946.93
R-2	5996.009	5635.598	NA	946.32	944.3	946.38
R-3	5081.521	5806.276	NA	947.14	945.4	947.16
R-4	6088.9.3	5947.316	NA	933.28	932.5	933.31

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Table 3-1

Elevation and Location Survey Results (Continued)

Well	North	East	Top of Inner Casing	Top of Outer Casing	Ground	Others
R-5	6208.371	5444.704	NA	937.79	934.8	NA
S-7	5222.674	6052.243	940.94	941.37	939.4	NA
W-1	5199.971	5617.222	NA	NA	NA	947.26
W-2	5524.425	5883.811	NA	NA	NA	945.29
W-10	5819.613	5530.858	NA	NA	NA	942.01
I-8D	5740.959	6495.957	933.46	933.90	931.1	NA
I-9	5903.980	6196.025	932.17	932.47	929.8	NA
I-11	6451.415	6288.993	933.42	933.55	931.4	NA
I-12	6694.869	5868.330	944.54	944.96	942.2	NA
I-13	7627.180	6631.564	933.47	933.92	931.0	NA
I-14	8330.522	6595.422	932.33	932.55	929.8	NA
R-7	5217.323	6052.616	941.55	942.06	939.5	NA
R-10	6264.057	5669.018	935.80	936.21	932.9	NA
R-12	6659.567	5859.974	945.35	945.83	943.0	NA
S-4	6034.764	5930.724	934.88	935.17	932.3	NA
S-11	6464.544	6289.611	934.04	934.52	931.7	NA
S-12	668.864	5876.873	944.93	945.26	942.1	NA

Note: NA = Not applicable.

the surface impoundment. Because the impoundment soil is being addressed as a regulated unit, it was not addressed by the RFI. A RCRA Closure Plan has been submitted to OEPA. Eleven soil borings were drilled in the other three areas in order to characterize the potential need for corrective action.

The soil boring locations for the Groundwater Quality Assessment Program and for the RFI are shown in Figures 3-3 and 3-4, respectively. Split-spoon soil samples were collected continuously at each boring and were logged by the WESTON geologist. Each boring was drilled and sampled to a total depth of 12 ft, auger refusal, or the water table, whichever came first. Up to three samples were retained from each boring for chemical analysis. Analytical samples were collected from default depths of 2 to 4 ft, 6 to 8 ft, and 10 to 12 ft below ground surface, unless the sampling depth was modified in the field by the WESTON geologist based on organic vapor detection, discoloration, odors, or lack of sample recovery. All soil samples were analyzed for VOCs. The drilling and sampling methods for soil borings are presented in Appendix F.

3.7 GROUNDWATER SAMPLING

The objective of the RFI groundwater sampling program was to characterize VOC and metals concentrations, to evaluate source areas, and to evaluate the horizontal and vertical extent of VOC migration. The following wells were sampled either as part of the RFI or as part of the quarterly impoundment sampling program:

- Two EKCO production wells (W-1 and W-10).
- Eight bedrock wells (R-1 through R-5, -7, -10, and -12).
- Thirteen interface wells (I-2, I-4 through -14, and I-8D).
- Eleven shallow wells (L-1 through L-5, S-4, -7, -11, -12, D-4-30, and P-3).

Prior to formal sampling of groundwater from all monitor wells, an in situ water sample was collected from each well and evaluated for dense nonaqueous phase liquids (DNAPLs). A

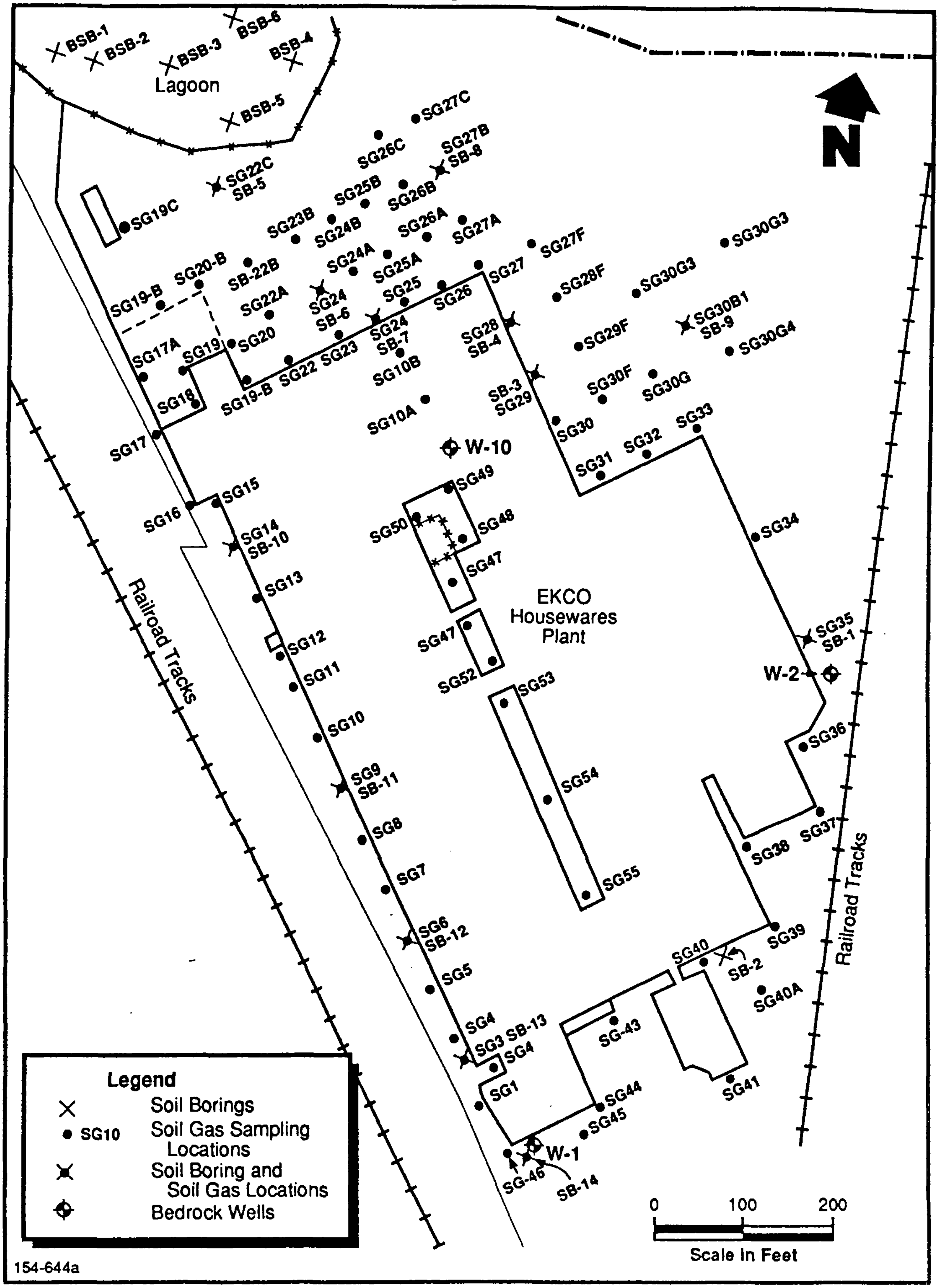

FIGURE 3-3 SOIL BORING AND SOIL GAS SAMPLING LOCATION MAP

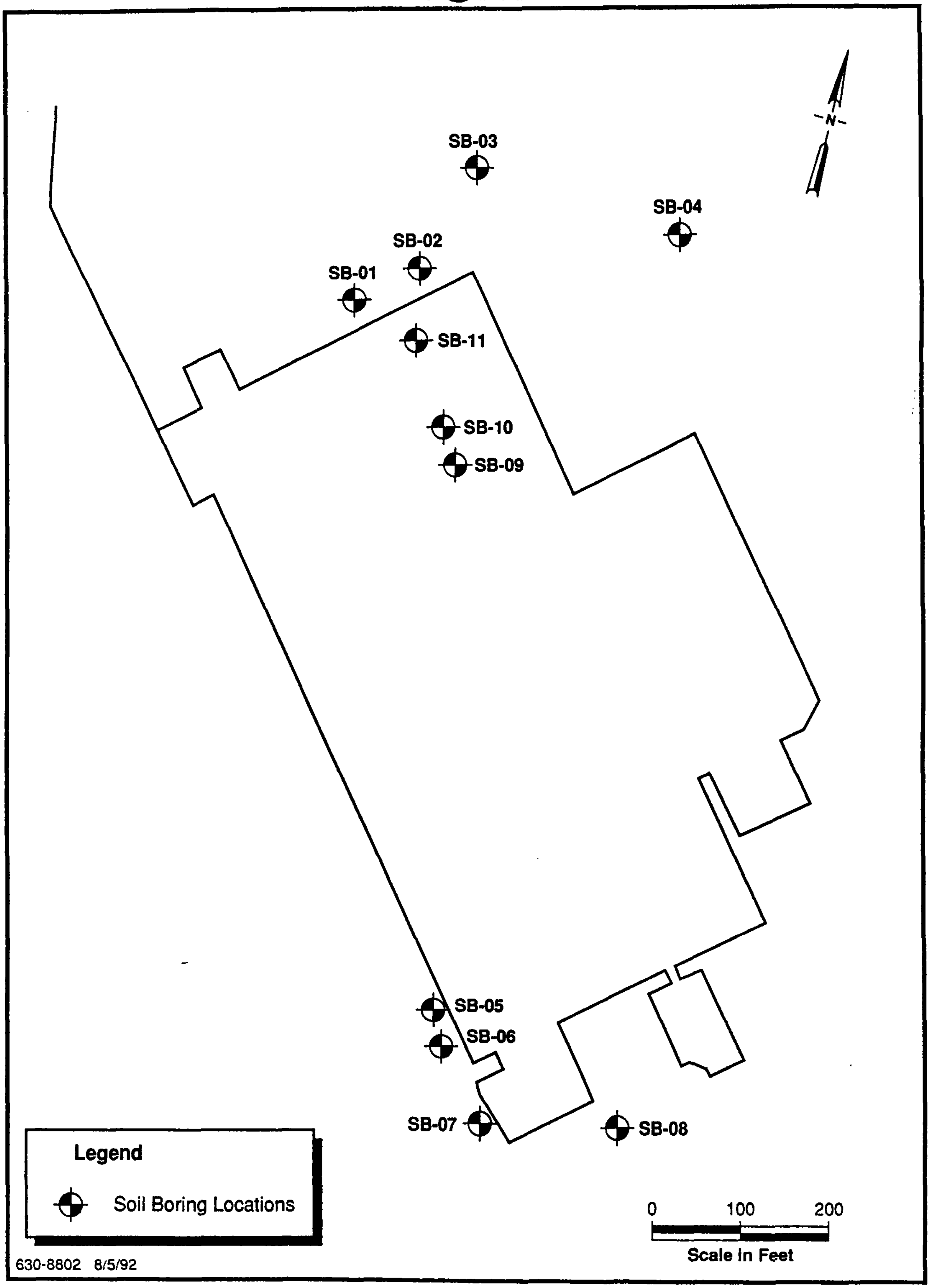

FIGURE 3-4 SOIL BORING LOCATIONS

best available technology (BAT) Envirotech hydroprobe sampler was used to collected the water sample at the base of each monitor well.

Monitor wells at the EKCO facility were sampled once during the Groundwater Quality Assessment Program in September 1988, and they were sampled twice during the RFI in September 1991 and March 1992. In addition, five shallow wells (L-1 through L-5) and four bedrock wells (R-1 through R-4) have been sampled quarterly in February, May, August, and November since May 1989. During the RFI, all of the monitor wells at the facility were sampled for VOC analysis, and all of the new RFI wells were also sampled for metals analysis. All of the previously existing wells had been sampled for VOC and metals analyses in 1988, and all of the metals concentrations were below the applicable Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act. The L-wells are sampled quarterly for VOC and metals analyses, and the four R-wells are sampled quarterly for VOC analysis only. During the RFI groundwater sampling, 28 wells were sampled in September 1991, and 24 wells were sampled in March 1992. Wells R-1 through R-4 were not sampled in 1992 as part of the RFI because they had been sampled 1 month earlier in February 1992, as part of the quarterly groundwater sampling program. The groundwater sampling method is presented in Appendix G.

3.8 TANK TIGHTNESS TESTING

3.8.1 Methodology

On 20 March 1991, four underground storage tanks were leak tested. The location of the tanks is shown in Figure 2-1. Tank tightness testing was performed by Midwest Tank Testing, Inc., a subcontractor for WESTON, using the Acu-Test leak computer system. This method is a temperature-compensated, volumetric test capable of detecting a leak in a tank at a rate within 0.05 gallon per hour. This system was the only one to meet and exceed all EPA standards and was ranked first in their evaluation study conducted at the Risk Reduction Laboratory in Edison, New Jersey.

The Acu-Test leak computer system, designed to function in an overfilled tank, measures changes in the product volume and product temperature in order to determine a volumetric flow rate. Changes in product volume are determined by measuring the amount of product that is added or removed to keep the product level in the fill tube constant. The amount of product added or removed is determined by the change in the weight (mass) of the supply of product maintained outside the tank, while a control loop using two optical detectors determines the time at which this addition or removal takes place.

To begin the test, the storage tank is filled until product stands in the fill pipe a minimum of 20 inches above the tank top, manway, or highest piping to be included in all tests. An API hydrometer is used to measure the specific gravity of the product. This value is given to the computer for future calculations. A small measuring cylinder is filled with additional product and placed near the fill pipe. A level sensor is placed within the fill pipe and connected to a control box, which activates either a solenoid valve or a pump, both of which are connected to the measuring cylinder. If the storage tank level rises, the level sensor causes the pump to remove liquid from the storage tank and pump it into the measuring cylinder. Conversely, a drop in product level results in an addition of product contained in the cylinder into the tank. The measuring cylinder is suspended from a load cell that is monitored by a computer. Any exchange of liquid with the storage tank is measured directly by the computer.

A temperature probe, which is inserted into the tank, has a series of seven thermistors located equally by volume across the diameter of the tank. The thermistors are connected to a sensitive Wheatstone bridge, which permits an accurate measurement of the change in temperature of the thermistors. The bridge is calibrated to zero before the test begins, and a temperature of ±3 °F range can be measured without readjustment of the bridge. The output of the Wheatstone bridge is also monitored by the computer, and a temperature change can be detected with a precision of ±0.0001 °F. Tank system changes are computed by using the coefficient of thermal expansion and the data collected by the system. The measured thermal volume changes are used to modify the amount of liquid to be added to or removed from the tank to establish a leak rate.

The top of the tank will usually be warmer or cooler than the bottom, depending on the temperature of the added product. The change in the average temperature with time is important in determining an accurate leak rate because such changes affect the amount of volumetric product expansion or contraction.

The computer samples cylinder weight and tank temperature changes approximately 250 times in a 1-minute cycle. At the end of each 1-minute cycle, the computer calculates the weight change from the previous cycle. This difference in weight converted to volume, and along with the calculated volumetric change caused by temperature variation, is used to calculate the leak rate for the cycle. The standard deviation of the average leak rate for the preceding 30 cycles is also calculated and displayed on the video screen. The tank is tight if the calculated average leak rate is less than 0.05 gallon per hour at a confidence level of 99%.

3.8.2 Tank Preparations

On 19 March 1991, the fill pipes for Tanks 3 and 5 were disconnected by EKCO to permit access to the tanks. EKCO operating personnel stated that these tanks had never been placed in service and had not previously been used to store material of any kind. In order to confirm this, a swab sample was obtained from each tank. To obtain a swab sample from each tank, a swatch of cotton fabric was securely wrapped around the end of a wooden pole that was normally used to check the level in tanks. The fabric was secured to the pole with duct tape. An HNu reading of the clean swab was taken. Subsequently, the swab was inserted into the tank through the opening in the fill pipe. The bottom of the tank was wiped by manipulating the pole. The swab was then removed from the tank, and a subsequent HNu reading was taken. The swab was visually inspected for signs of contamination. Both tanks were confirmed to be clean. Subsequently, approval was given by EKCO to fill both tanks with water. Water was added from a tank truck during the late morning and early afternoon of 19 March 1991.

Both solvent blend tanks (Tanks 2 and 4) were taken out of service and filled with solvent during the morning of 19 March 1991 from a tank truck. EKCO operating personnel then "dipped" the tanks to confirm that both were filled. Tank 4 was apparently 200 gallons short of being filled. Tank 2 was apparently filled.

Drop tubes on all tanks were removed 20 March 1991. This action affected the apparent level in each tank. In each case, additional material was added to raise the liquid level so that the fill pipe was partially filled as required for proper testing. Solvent blend was added to Tanks 2 and 4 from drums by EKCO operating personnel. Tank 4 required approximately four drums of material, whereas Tank 2 need eight drums. Possible explanations are an error in measurement, an air pocket caused by an obstructed vent line, or the unauthorized use of the material in the tank for processing during the evening or night shifts.

Midwest Tank Test arrived on-site at approximately 9:30 a.m. on 20 March 1991. Their personnel proceeded to inspect the tank preparations and to set up the tank testing equipment. The level sensor and temperature probe were all installed in the fill lines of each tank. All tests began that morning and were completed in the afternoon. All testing was performed in the presence of a an EPA Region V contractor representative, Barry R. Nelson, who is a geologist with Metcalf & Eddy, Inc.

SECTION 4
FINDINGS

This section discusses the results and the interpretation of the data gathered from the RFI activities. The following activities and topics are discussed in this section:

- Geophysical logging
- Packer testing
- Pump testing
- Soil sampling
- Site geology
- Site hydrogeology
- Groundwater sampling and chemical migration

These results and interpretations are currently being used to evaluate potential environmental corrective measures at the EKCO site.

4.1 GEOPHYSICAL LOGGING RESULTS

Packer tests were conducted on the two bedrock wells R-1 and R-2 in April 1991. Prior to performing the packer tests, geophysical logging was conducted on wells R-1, R-2, and R-4 in order to obtain information necessary for selecting packer intervals and to assist in evaluation of the geology at the site. The suite of geophysical logs run on wells R-1 and R-2 included the caliper log, gamma log, resistivity log, and the spontaneous potential log. All of these logs except the caliper log were also run on Well R-4. No packer testing was to be conducted in this well, and only lithologic information was needed. The results of the geophysical logging of wells R-1, R-2, and R-4 revealed three important characteristics about the geology and hydrogeology beneath the EKCO facility:

- A fairly thick (approximately 50 ft), relatively permeable and laterally continuous sandstone exists in each well which, in packer tests, contributed over 90% of the total yield in wells R-1 and R-2.

- Overlying the productive sandstone in wells R-1 and R-2 is an alternating sequence of low permeability shales and argillaceous sandstones, which collectively serves to reduce the groundwater flow from the overlying glacial deposits to the underlying sandstone sandstone.

- Erosion of the bedrock surface (during Quaternary glaciation) effectively removed the low permeability shales and argillaceous sandstones in the vicinity of well R-4. As a result, the productive sandstone in well R-4 is directly overlain by the thick sequence (approximately 89 ft) of unconsolidated glacial outwash deposits.

Figure 4-1 shows an interpretive geologic cross-section of the stratigraphic units penetrated by wells R-1, R-2, and R-4. The cross-section is based primarily on the results of the geophysical logs, driller's logs, and regional data from the U.S. Geological Survey (USGS). Copies of the geophysical logs from wells R-1, R-2 and R-4 are provided in Appendix H.

The productive sandstone unit that exists in the three wells is indicated on the logs by a low gamma response [approximately 10 counts per second (cps)] and a correspondingly high electrical resistance. The low gamma activity implies a low percentage of fine-grained materials in the matrix of this sandstone member, which accounts for its relatively permeable nature. The overlying argillaceous sandstones in wells R-1 and R-2, indicated on the logs by relatively moderate gamma response (30 to 50 cps), implies the presence of interstitial clay or silts, which reduce the permeability of water-bearing geologic deposits.

The shale beds in wells R-1 and R-2 are indicated on the logs by a relatively high gamma response (50 to 70 cps) and a correspondingly low electrical resistance. Shales are typically low in permeability unless secondary fracturing has occurred. The sedimentary rocks in the region of the site have not undergone any appreciable deformation and, in fact, dip only slightly to the southeast (USGS).

4.2 PACKER TESTING RESULTS

The objectives of the packer testing were to evaluate the hydrogeology, the bedrock groundwater VOC concentration, and the casing seat integrity of the deep open borehole bedrock wells. Five packer tests were conducted at the site, three on Well R-1 and two on Well R-2. A falling head casing seat test was also conducted on Well R-2. The pumping

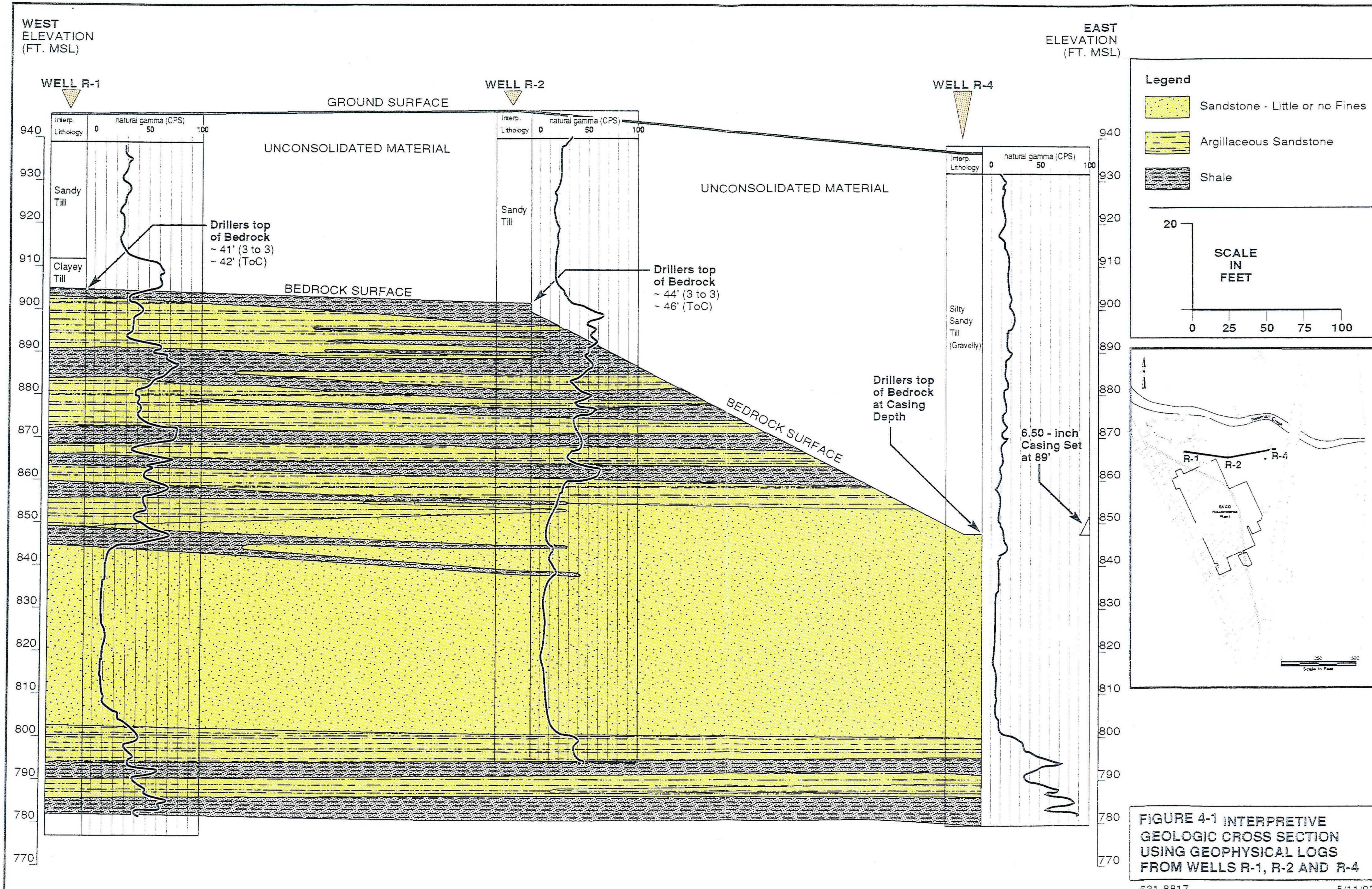

FIGURE 4-1 INTERPRETIVE GEOLOGIC CROSS SECTION USING GEOPHYSICAL LOGS FROM WELLS R-1, R-2 AND R-4

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times of the five tests ranged from 100 to 180 minutes, and the maximum pumping rates ranged from 0.2 to 24 gallons per minute (gpm), depending on the yielding capacity of the tested zone. The specific capacities were calculated for each test zone and ranged from 0.0069 to 1.82 gpm/ft. A summary of the packer test results is shown in Table 4-1. The packer test zones were numbered from the bottom to the top of the wells. During the Zone 1 test in both wells (R-1 and R-2), the bottom packer was left uninflated in order to evaluate the entire bottom portion of the well, from the upper packer depth to the total depth of the well.

Groundwater samples were collected from each tested zone and analyzed for VOC in order to evaluate the vertical profile of VOC in the bedrock groundwater. A summary of the packer test groundwater sampling results is shown in Table 4-2. During all but one of the tests (R-2/Zone 2), two time series samples were collected to evaluate how the VOC concentrations changed as pumping progressed. The results indicated that the VOC concentrations for each zone did not change appreciably with time. The total VOC concentrations ranged from 227 parts per billion (ppb) (R-1/Zone 1) to 1,100 ppb (R-2/ Zone 2). The lowest VOC concentration was found in the deepest zones in both Wells R-1 and R-2.

4.2.1 Well R-1 Packer Testing Results

The packer test spacing intervals for wells R-1 and R-2 were plotted adjacent to the geologic and geophysical logs, in order to display the lithologies that were tested. Figure 4-2 shows the packer test intervals for Well R-1. The upper packer in Zone 1 was seated in a 4-ft thick shale layer from 98 to 102 ft below ground surface (bgs), and the lower packer was left uninflated. Directly underlying the shale layer in Zone 1 is 42 ft of sandstone with apparently very little or no fine material. Below the sandstone is approximately 21 ft of alternating layers of argillaceous sandstone and shale. Zone 2 was located directly above Zone 1 and straddled 20 feet of argillaceous sandstone and shale from 78.8 to 98.0 ft bgs. Zone 3 was located directly above Zone 2 and straddled 12 ft of argillaceous sandstone from 61.6 to 73.6 ft bgs.

Table 4-1

Packer Test Activities Summary Table

Well/ Zone	Test Date	Time Start Pump	Time Stop Pump	Total Pump Time (min)	Max Q (gpm)	Specific Capacity (gpm/ft)	Packer Spacing	Depth to Water Before Packer Inflation	Depth to Water After Packer Inflation (ft)		
									Above Upper Packer	Between Packers	Below Lower Packer
R-1/Z-1	4/16/91	11:05	12:45	100	24	1.82	102-TD (165)	42.80	42.74	49.40	NI
R-1/Z-2	4/17/91	16:15	19:15	180	0.3	0.0069	78.8-98.0	43.21	43.04	40.33	50.05
R-1/Z-3	4/16/91	15:40	17:30	110	0.8	0.06	61.6-73.6	43.03	42.12	43.08	48.55
R-2/Z-1	4/18/91	13:10	14:50	100	22	1.80	87.8-TD (150)	30.05	28.43	48.85	NI
R-2/Z-2	4/18/91	17:07	19:30	143	0.2	0.0087	63.6-84.0	31.32	27.95	33.02	48.79

Notes: NI = Lower packer not inflated.
Q = Flow rate in gallons per minute.
s = Drawdown in feet.

Table 4-2

Packer Test Groundwater Sampling Results

Well/Zone	Total Time of Test (min)	Total Well Volumes Purged	Sample	Sample Date	Sample Time	Test Time of Sample (min)	Volumes Purged When Sampled	Total VOCs (ppb)
R1/Z1	100	18.0	A	4/16/91	12:20	75	12.5	227
			B	4/16/91	12:45	100	18.0	248
R1/Z2	240	1.5	A	4/17/91	18:15	120	1.0	506
			B	4/17/91	19:15	180	1.5	496
R1/Z3	110	4.0	A	4/16/91	16:30	50	2.5	297
			B	4/16/91	17:30	110	4.0	348
R2/Z1	100	18.5	A	4/18/91	14:15	65	12.0	872
			B	4/18/91	14:45	95	18.5	769
R2/Z2	143	1.7	A	4/18/91	19:30	143	1.7	1,100
			B	NS	NS	NS	NS	NS
R2/Hydrant*	NA	NA	NA	4/19/91	NA	NA	NA	6

*Sample of the fire hydrant water which was used for the falling head test.

Notes: NS = The second sample (Sample B) was not collected during this test due to the low yield of the well.
NA = Not applicable; referenced sample was taken from a falling head test and no water was purged from the well.

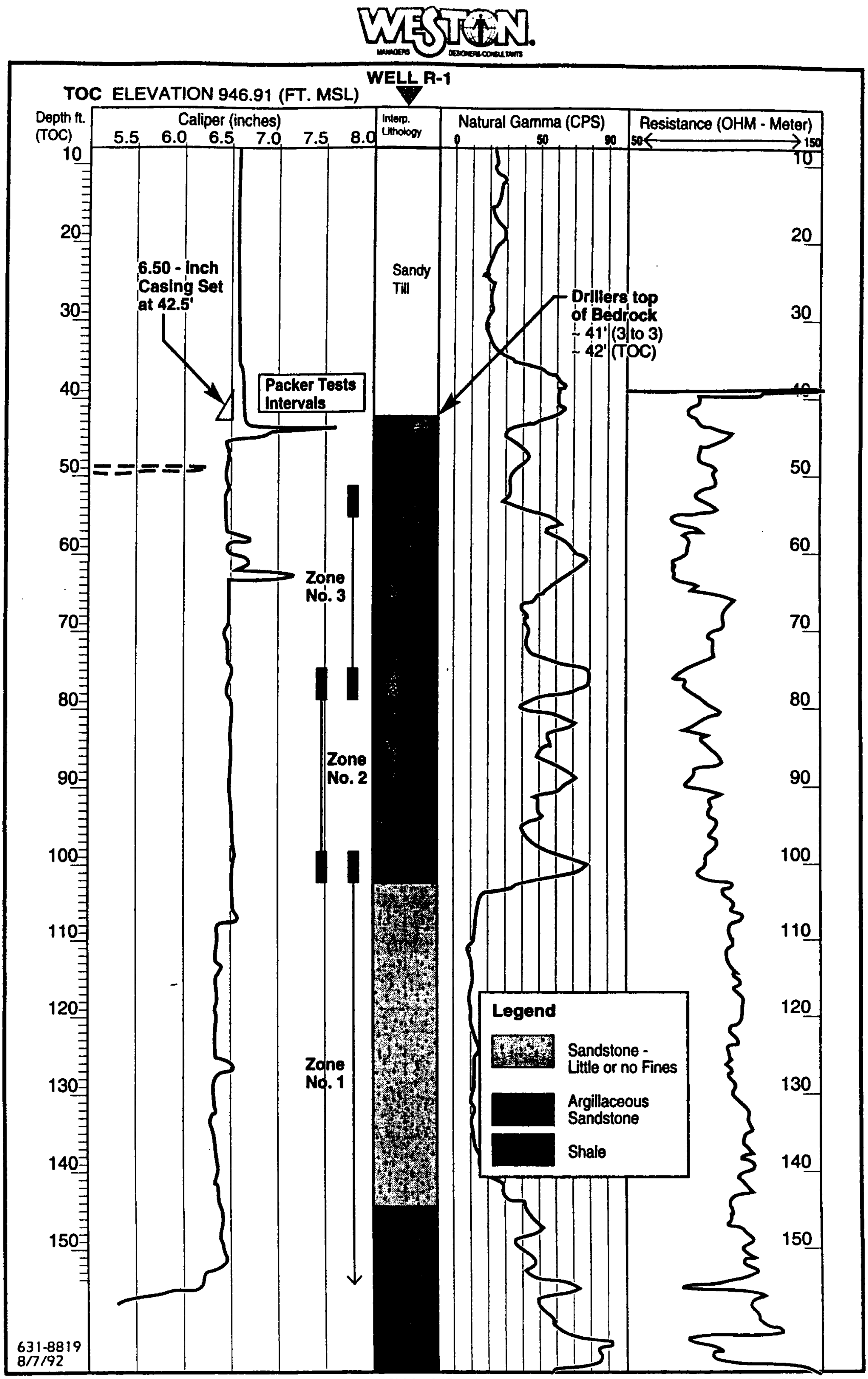

FIGURE 4-2 PACKER TEST INTERVALS, GEOLOGICAL AND GEOPHYSICAL LOGS FOR MONITOR WELL R-1

Water levels were continuously measured in the tested well during each packer test at three locations in the borehole; above the upper packer, between the two packers and below the lower packer. As can be seen in Table 4-1, there was a downward gradient from above the upper packer to between the packers and from between the packers to below the lower packer in every test except one, R-1/Zone 2. In test R-1/Zone 2, there was a downward gradient from between the packers to below the bottom packers, but there was an upward gradient from between the packers to above the upper packer. The static water level below the upper packer was higher than the bottom of the overlying confining shale bed for all five of the tested zones, indicating that they were all under semi-confined conditions. Water levels were also continuously measured during each test in the five observation wells (I-2, L-2, R-4, and R-1/R-2). Time-drawdown graphs were plotted for all of the tests and are discussed below.

The time-drawdown graph for Well R-1 during the Zone 1 packer test is shown in Figure 4-3. The flow rate was stepped up four times to a maximum rate of 24 gpm. The head below the upper packer in Zone 1 was lowered 13.2 ft during the drawdown and fully recovered when pumping was terminated. The head above the packer did not change during the test indicating that the packer seat was not leaking and that the overlying shale acted as a barrier to groundwater flow for the duration of the test. Figure 4-4 shows the time-drawdown graphs for the five observation wells monitored during the Zone 1 test. The times when pumping in Well R-1 was initiated and terminated are indicated on each graph. As can be seen in this figure, no pumping-related drawdown occurred in any of the observation wells during the test.

The time-drawdown graph for Well R-1, test Zone 2 is shown in Figure 4-5. The flow rate was adjusted to a maximum rate of 0.3 gpm. Some minor fluctuations occurred in the pumping rate and the drawdown. The sudden drawdown indicated on Figure 4-5 at approximately 30 minutes was caused by a leaking check valve; this was repaired and the test resumed at approximately 50 minutes. The head between the packers was lowered 50 ft during the drawdown test then fully recovered when pumping was terminated. The heads above the upper packer and below the lower packer did not change during the test. The

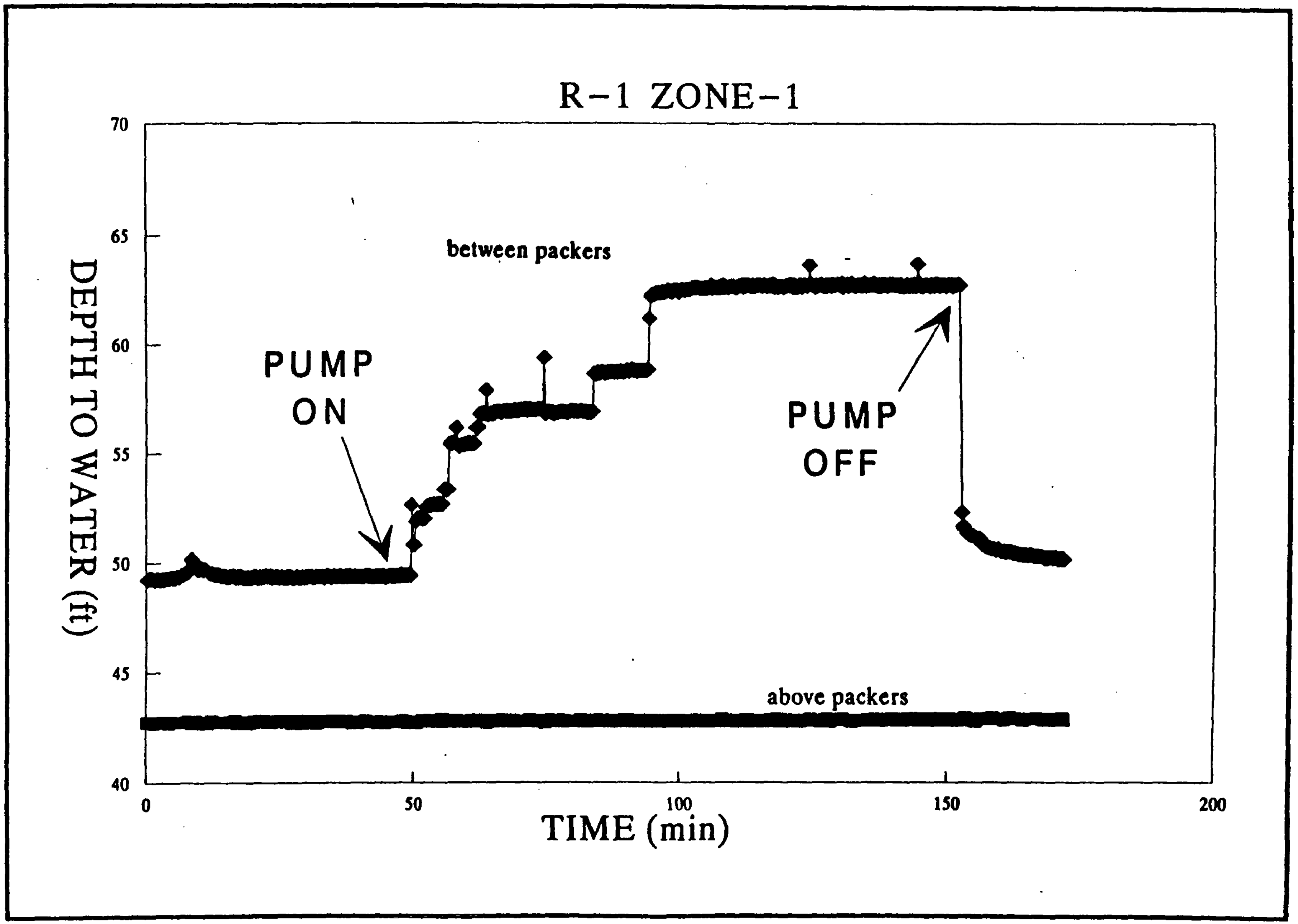

FIGURE 4-3 WATER LEVEL DRAWDOWN CURVES FOR THE PUMPING WELL FOR TEST R-1, ZONE-1

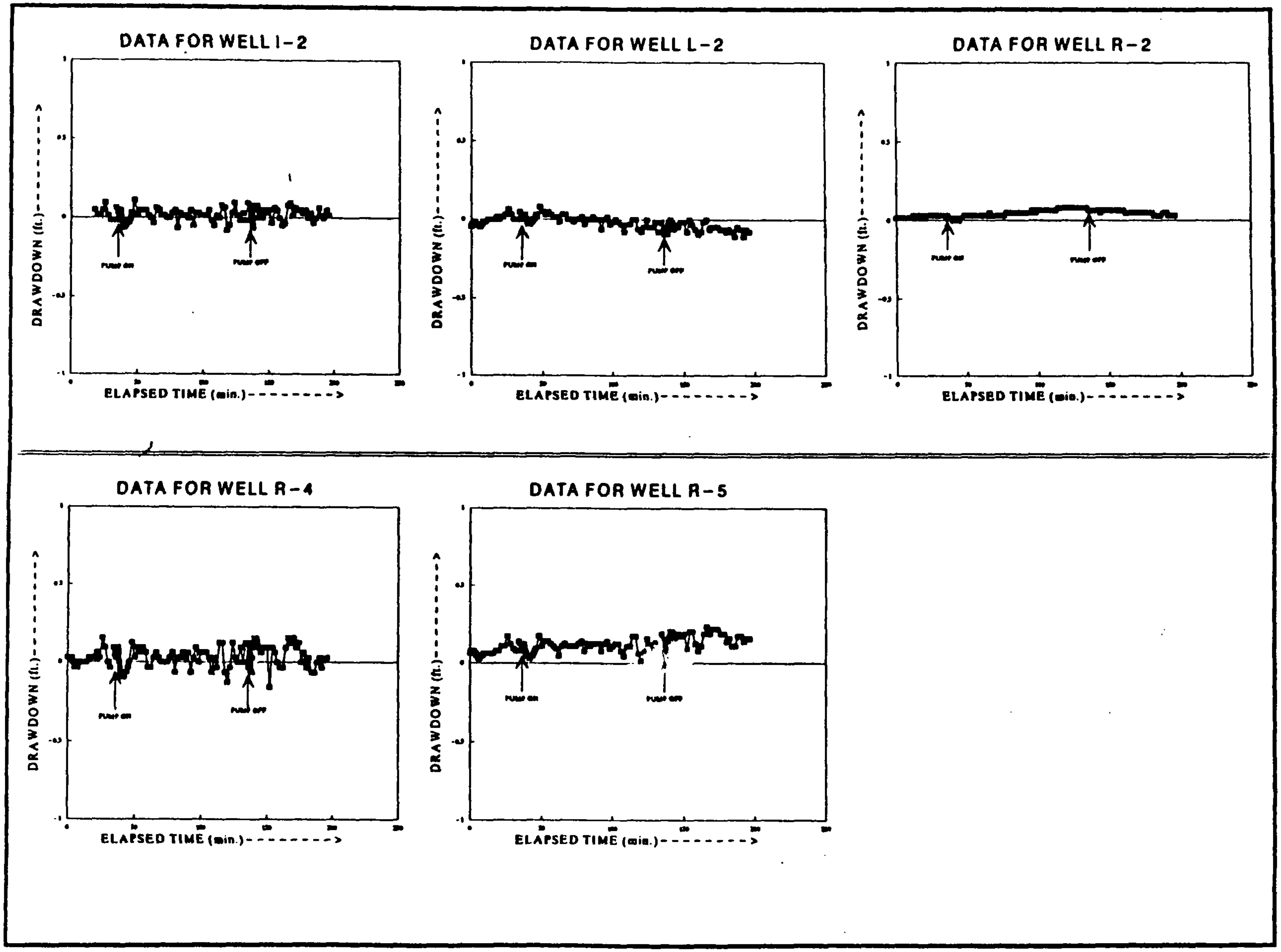

FIGURE 4-4 WATER LEVEL DRAWDOWN CURVES FOR THE OBSERVATION WELLS FOR TEST R-1, ZONE-1

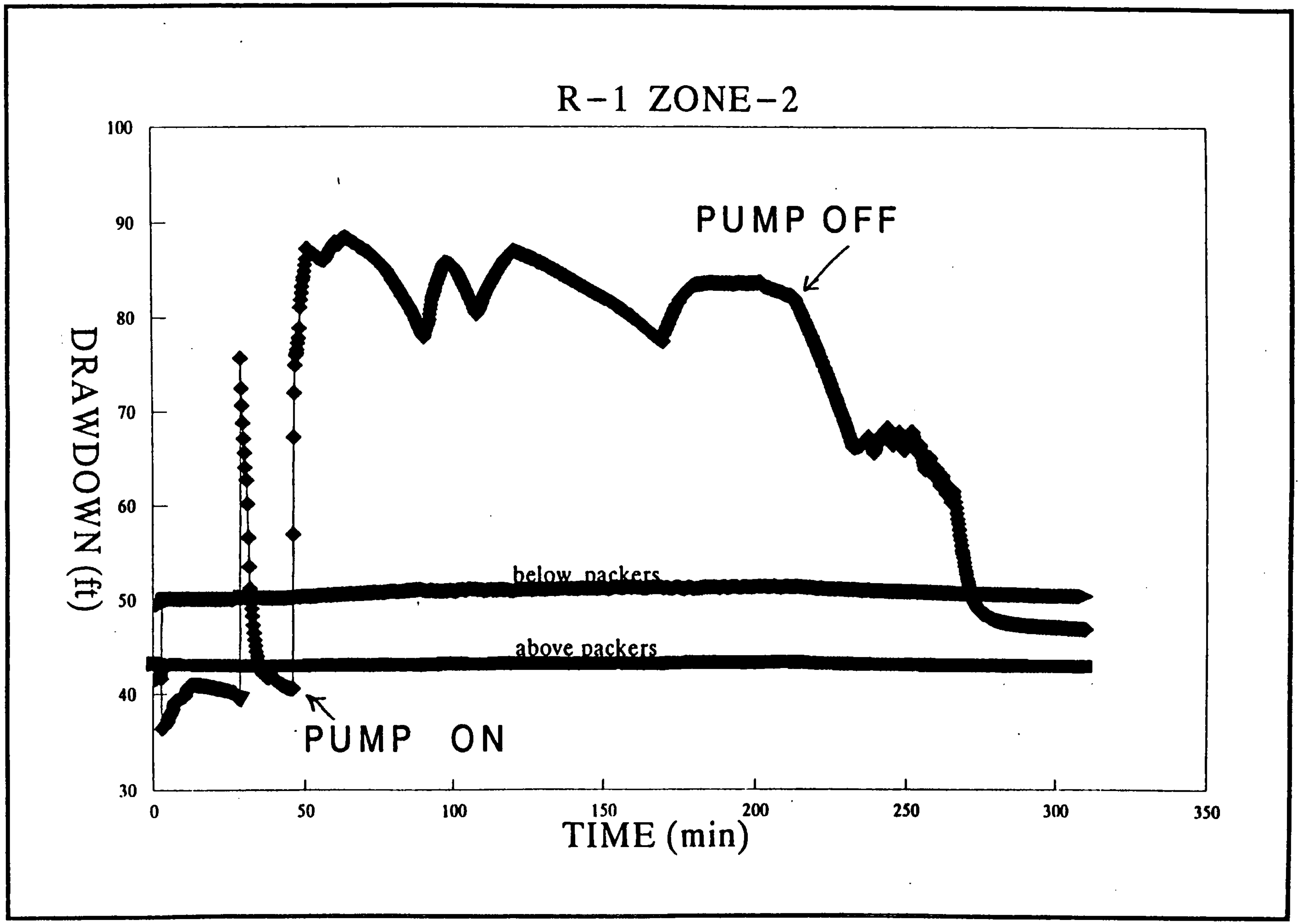

FIGURE 4-5 WATER LEVEL DRAWDOWN CURVES FOR THE PUMPING WELL FOR TEST R-1, ZONE-2

time-drawdown graphs for the Zone 2 observation wells in Figure 4-6 show that none of the wells was affected by the pumping of Zone 2. Figure 4-7 shows the time drawdown graph for Well R-1 test Zone 3. The head between the packers was lowered 14 ft during the drawdown test, then fully recovered when the pumping was terminated. The head above the upper packer did not change during the test, but the head below the lower packer was lowered approximately 1 ft when pumping was initiated, then quickly equilibrated. This may have been due to an initial leak around the packer or minimal groundwater movement through the lower shale layer. The time-drawdown graphs for the Zone 3 observation wells in Figure 4-8 show that none of the wells was affected by the pumping of Zone 3.

4.2.2 Well R-2 Packer Testing Results

Two zones were packer tested in Well R-2. The packer test intervals, along with the geological and geophysical logs, are shown in Figure 4-9. The upper packer in Zone 1 was seated in a 4-ft-thick shale bed from 83 to 87.8 ft bgs and the lower packer was left uninflated. Directly underlying the shale layer in Zone 1 is 58 ft of sandstone with very little or no fine material. Below the sandstone is approximately 10 ft of silty shale. Zone 2 was located directly above Zone 1 and straddled 20 ft of shaley sandstone and shale from 63.6 to 84.0 ft bgs. In addition to the two packer tests, a falling head test was conducted at the casing bottom/bedrock interface to determine the integrity of the casing seal.

Figure 4-10 shows the time-drawdown graph for test R-2/Zone 1. The head below the upper packer was drawn down 12.2 ft during the drawdown test and fully recovered when pumping was terminated. The head above the packer did not change during the test. The time drawdown graphs for Zone 1 observation wells shown in Figure 4-11 indicate that the water level in well R-4 was drawn down approximately 0.2 ft and then fully recovered when pumping was terminated. No other observation wells was affected by the pumping of Well R-2.

Figure 4-12 shows the time-drawdown graph for test R-2 Zone 2. The head between the packers was lowered 23 ft during the drawdown test and fully recovered when pumping was

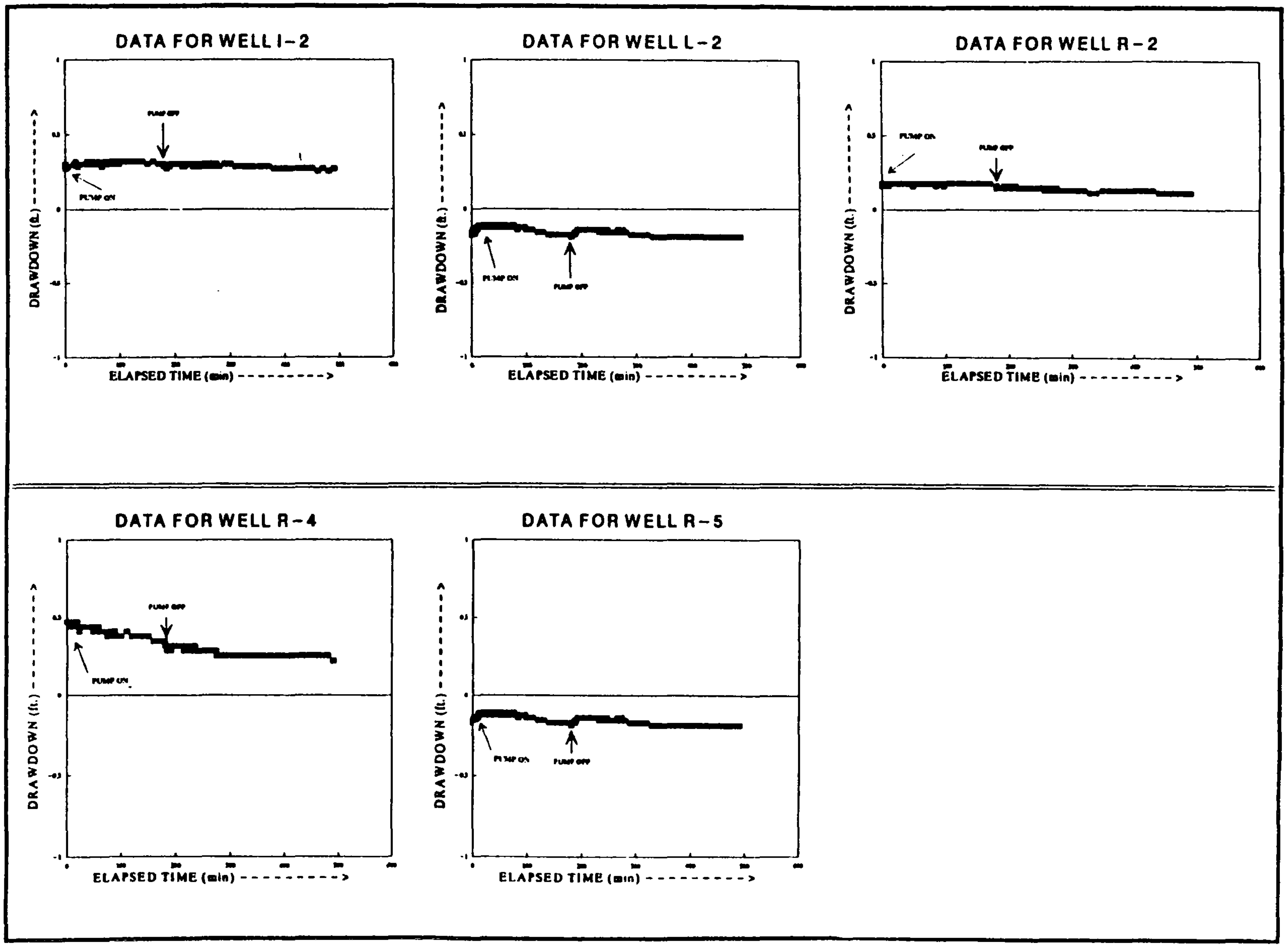

FIGURE 4-6 WATER LEVEL DRAWDOWN CURVES FOR THE OBSERVATION WELLS FOR TEST R-1, ZONE-2

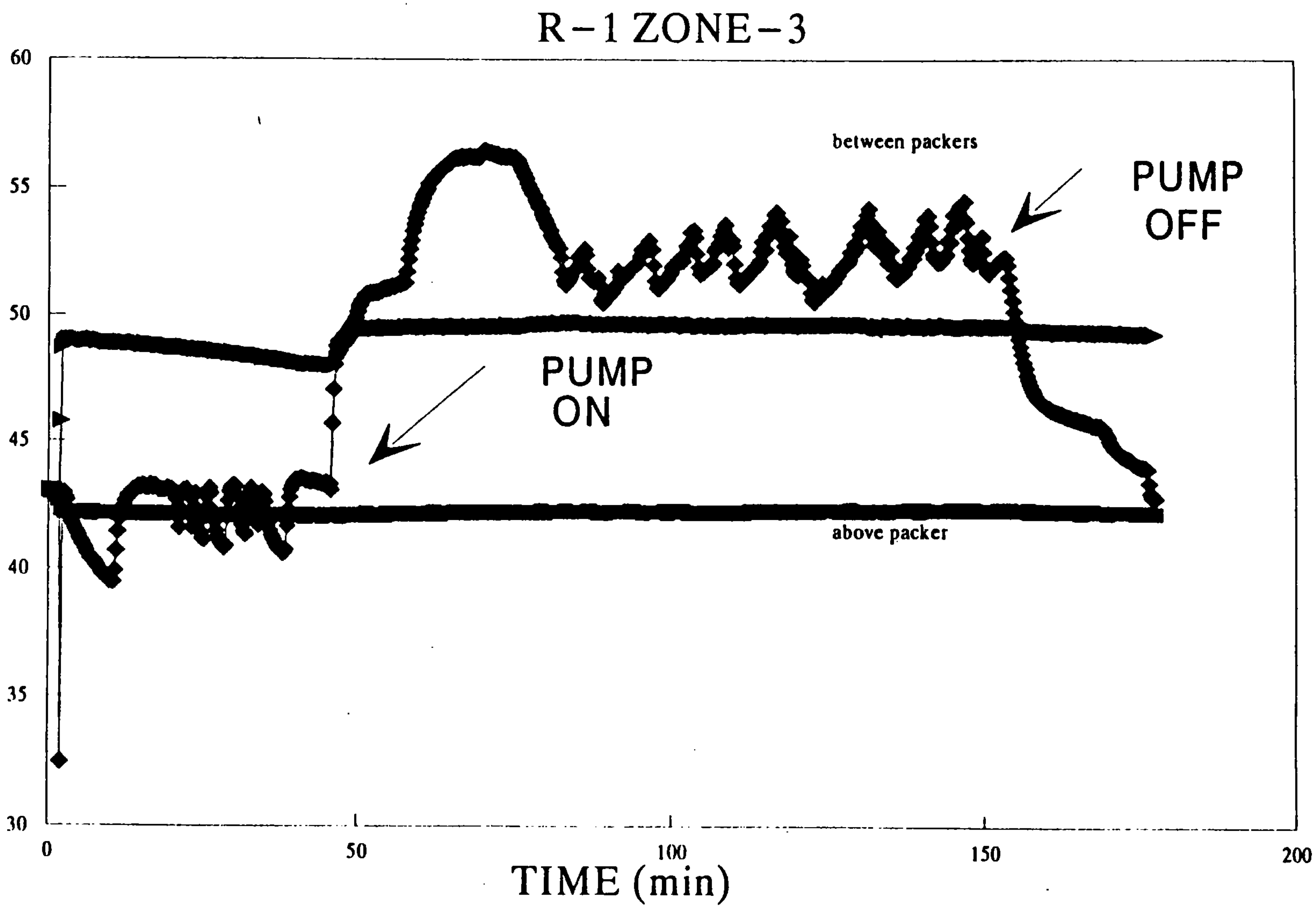

FIGURE 4-7 WATER LEVEL DRAWDOWN CURVES FOR THE PUMPING WELL FOR TEST R-1, ZONE-3

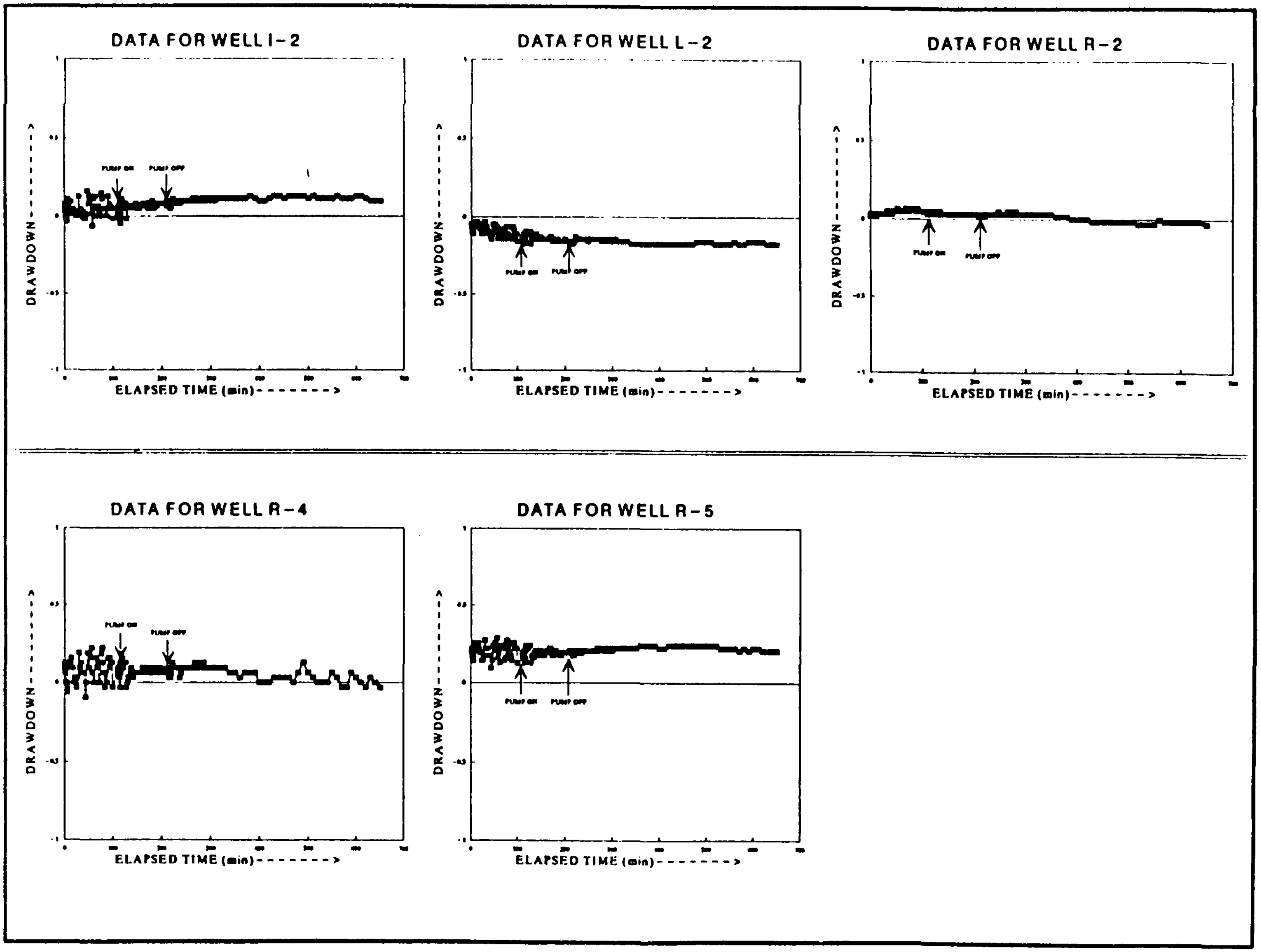

FIGURE 4-8 WATER LEVEL DRAWDOWN CURVES FOR THE OBSERVATION WELLS FOR TEST R-1, ZONE-3

WESTON

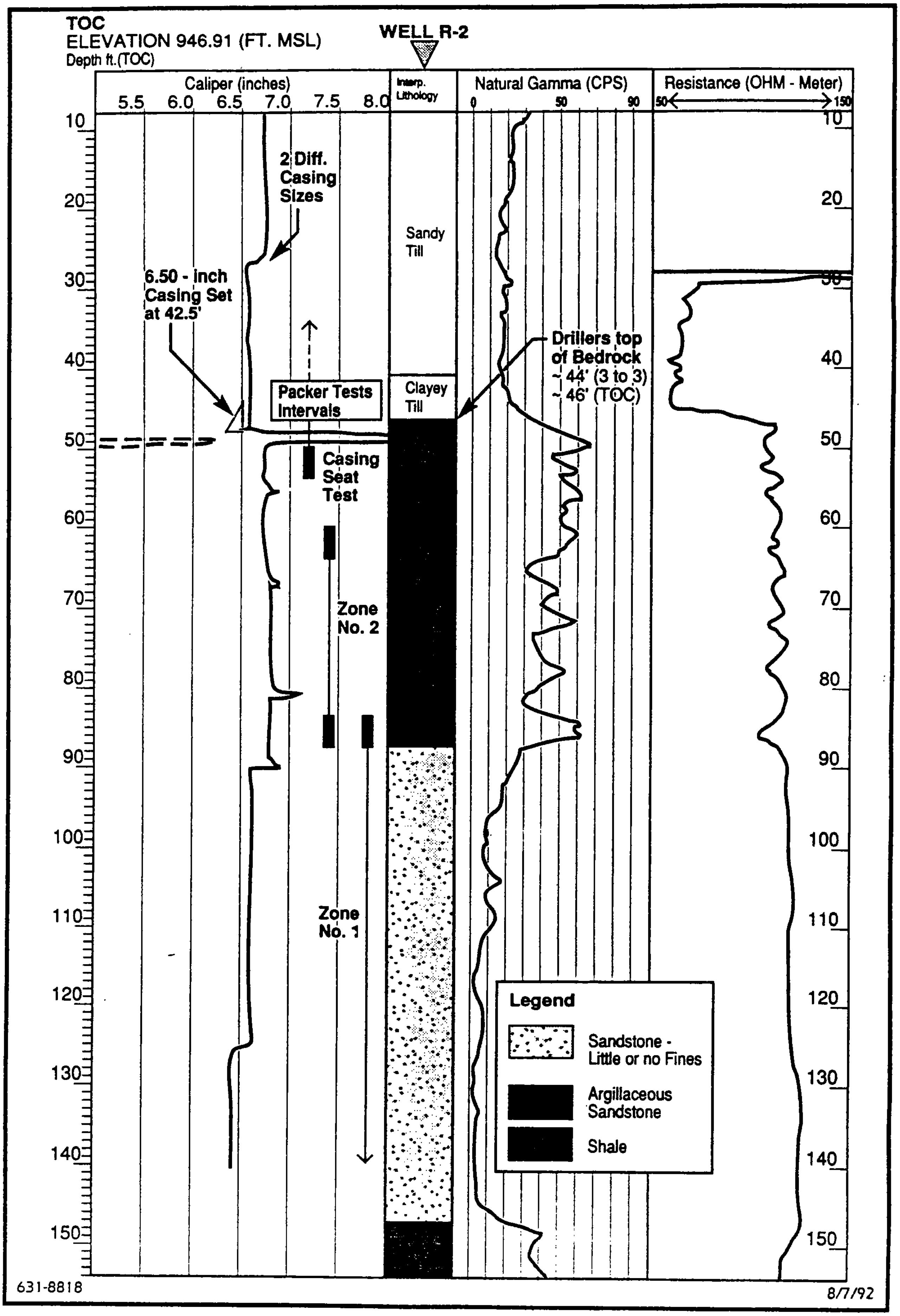

FIGURE 4-9 PACKER TEST INTERVALS, GEOLOGICAL AND GEOPHYSICAL LOGS FOR MONITOR WELL R-2

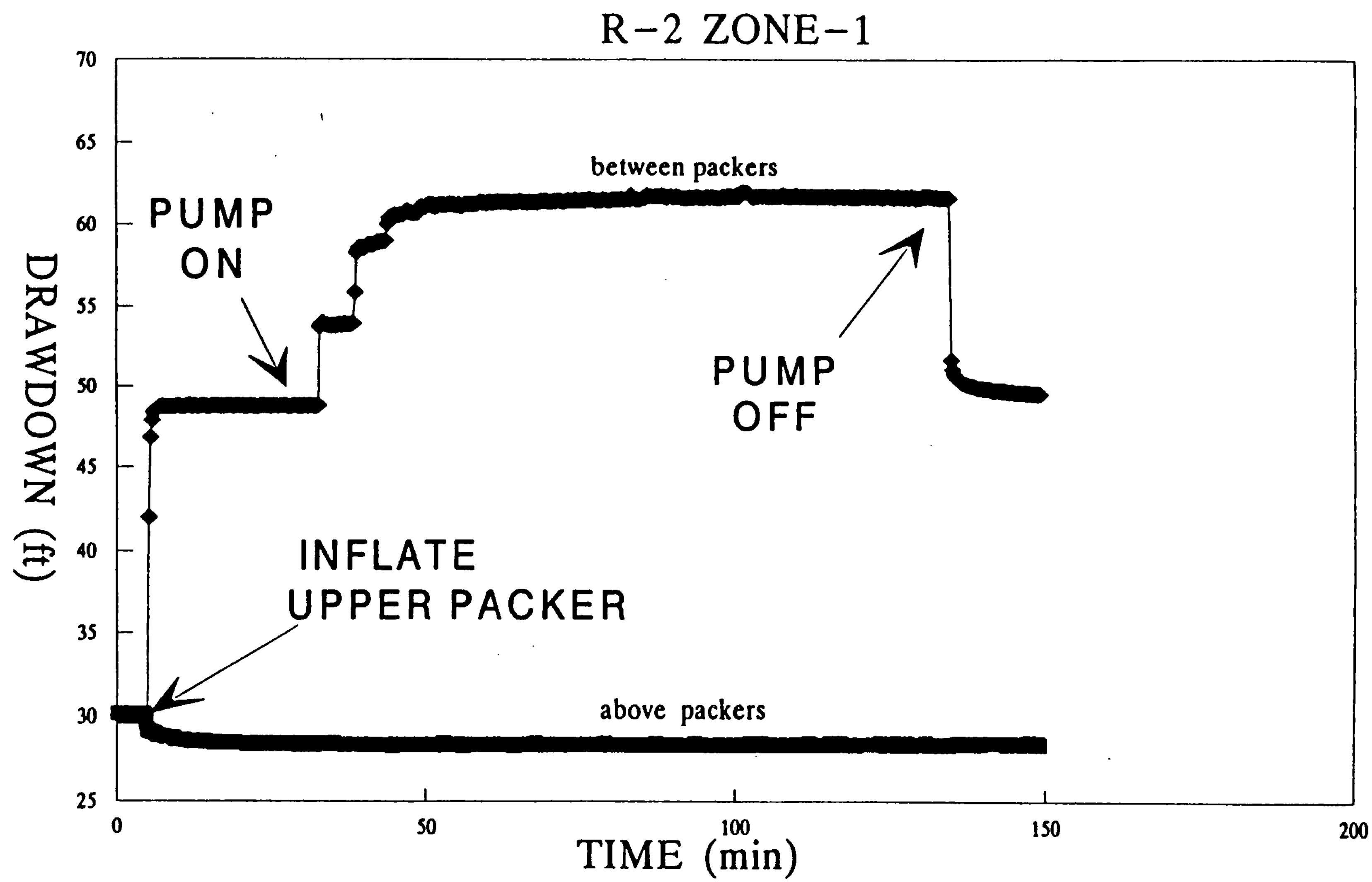

FIGURE 4-10 WATER LEVEL DRAWDOWN CURVES FOR THE PUMPING WELL FOR TEST R-2, ZONE-1

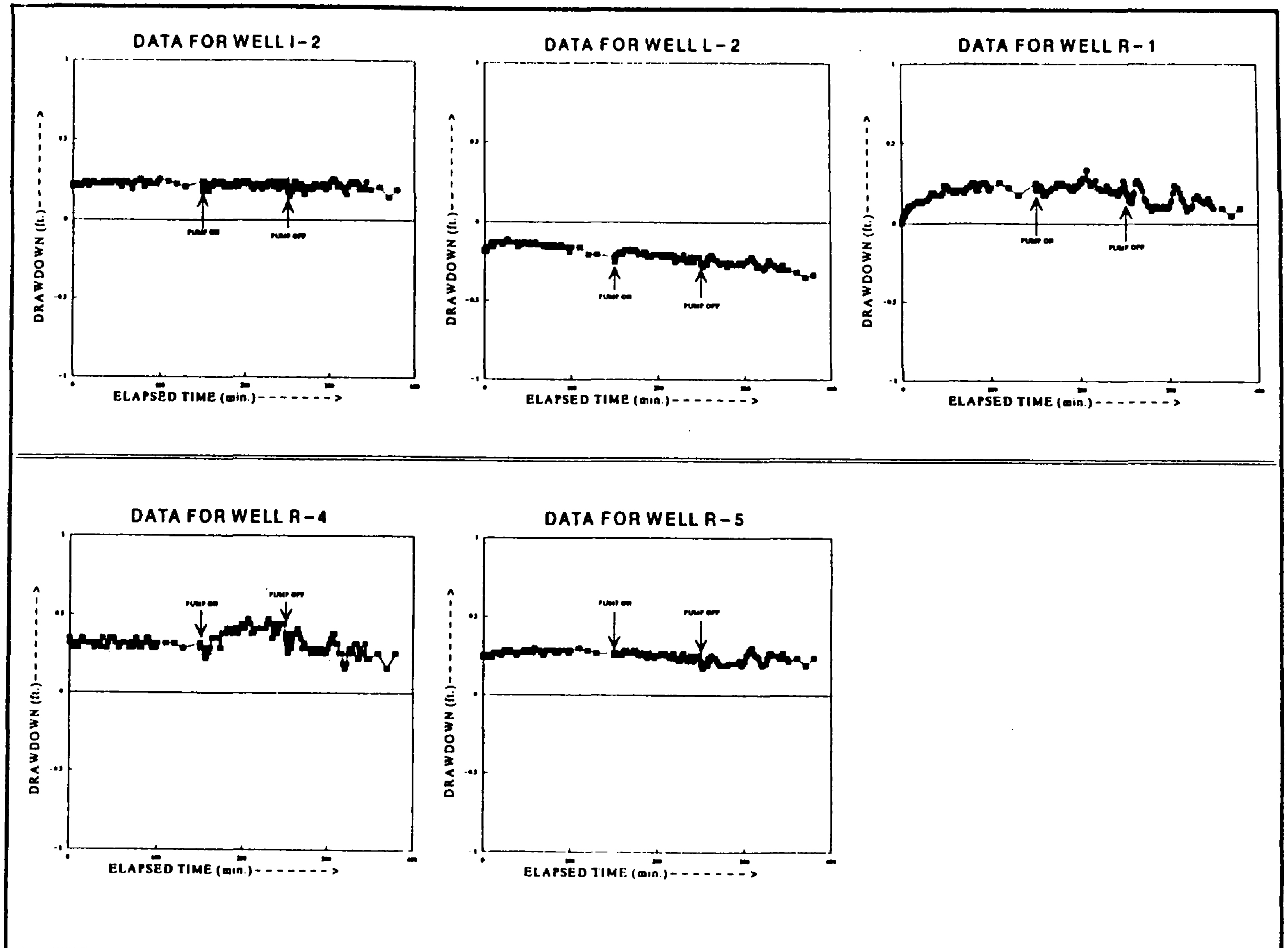

FIGURE 4-11 WATER LEVEL DRAWDOWN CURVES FOR THE OBSERVATION WELLS FOR TEST R-2, ZONE-1

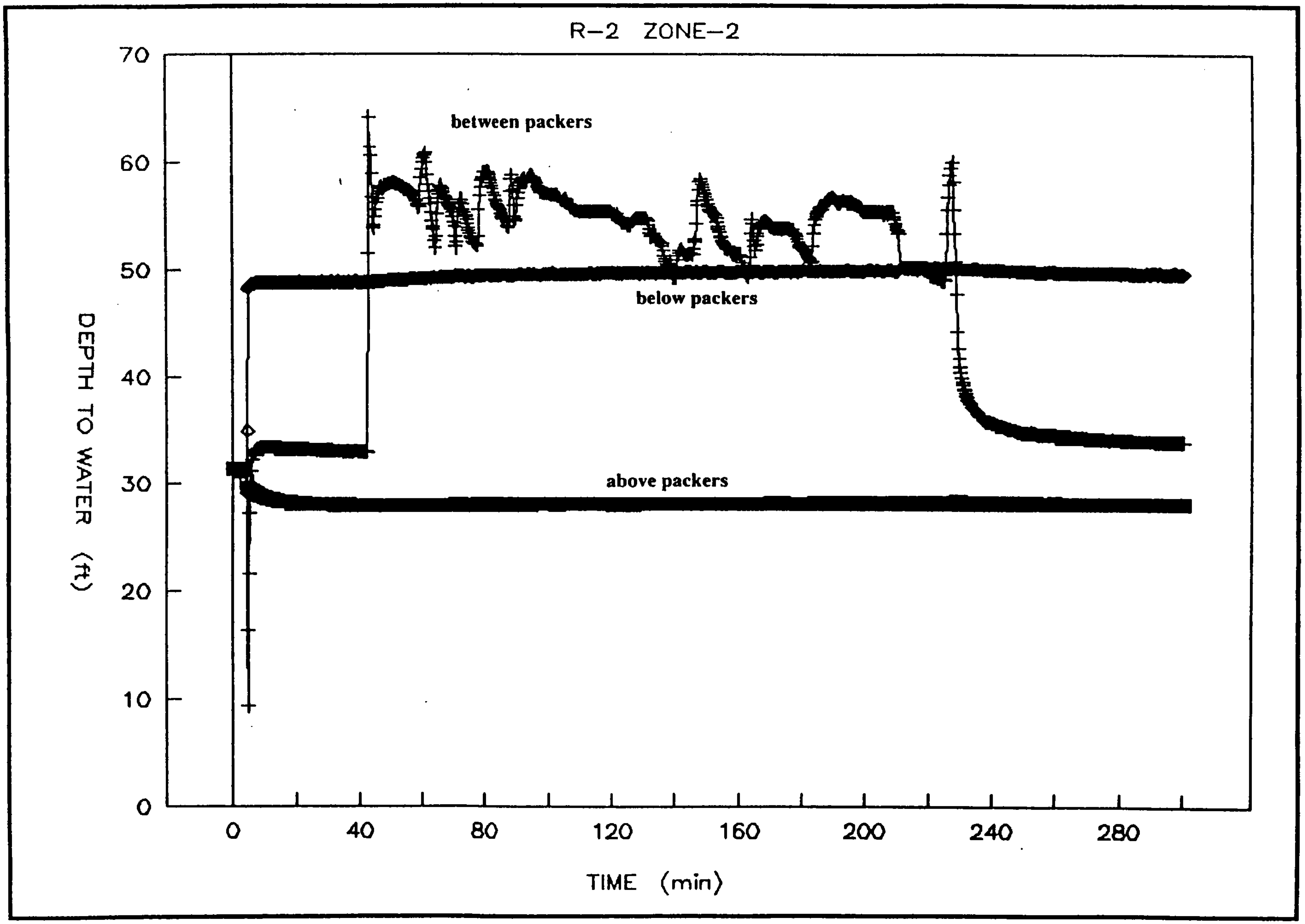

FIGURE 4-12 WATER LEVEL DRAWDOWN CURVES FOR THE PUMPING WELL FOR TEST R-2, ZONE-2

terminated. Heads above and below the packers did not change during the test. The time-drawdown graphs for the five observation wells on Figure 4-13 show that none of the wells was affected by the pumping of test R-2/Zone 2.

A falling head casing seal test was conducted on well R-2 by inflating the top packer 2 ft below the bottom of the casing and sealing off the upper 2 ft of the borehole from the rest of the well (Figure 4-9). The 2-ft zone that was left open consisted entirely of relatively low permeability shale. The well was filled up to the surface with potable water and the water level in the well was monitored. If there were a proper casing seal in place, the water level in the well would have remained relatively constant; however, after the casing was filled to the surface, the water level quickly dropped back to static conditions. The water recharged much more rapidly than would be reasonable considering the relatively limited permeability of the exposed 2-ft thick shale interval. The hydraulic conductivity was calculated from the falling head data using the Bouwer and Rice falling head test method (Bouwer and Rice, 1976) to be 6.29 ft/day. This value is within the range for an unconsolidated sand material (Freeze and Cherry, 1979), and several orders of magnitude higher than would be expected for the 2-ft shale interval, which was isolated during the test. This implies that the water leaked around the casing and into the highly permeable unconsolidated material above. The falling head test data is included in Appendix I, and copies of the drillers' logs for wells R-1 through R-4 are included in Appendix J.

Three other bedrock monitoring wells (R-1, R-3, and R-4) were installed at the same time as well R-2, using the same driller and drilling method. This suggests the possibility that the casing seal between the bedrock and the unconsolidated sediments in those wells may also be leaking. Wells R-3 and R-4 are a minor concern because the levels of VOC are low (90 ppb and 1.75 ppb, respectively). In addition, at Well R-3 the top of bedrock is so near to the ground surface that the unconsolidated sediments are dry; therefore, there is little potential for groundwater to readily migrate from the unconsolidated sediments to the bedrock aquifer. Also, at Well R-4, the low permeability shale has been eroded away and the unconsolidated sediments are in direct contact with the highly permeable sandstone aquifer (Figure 4-1). This geology allows for the groundwater in the unconsolidated

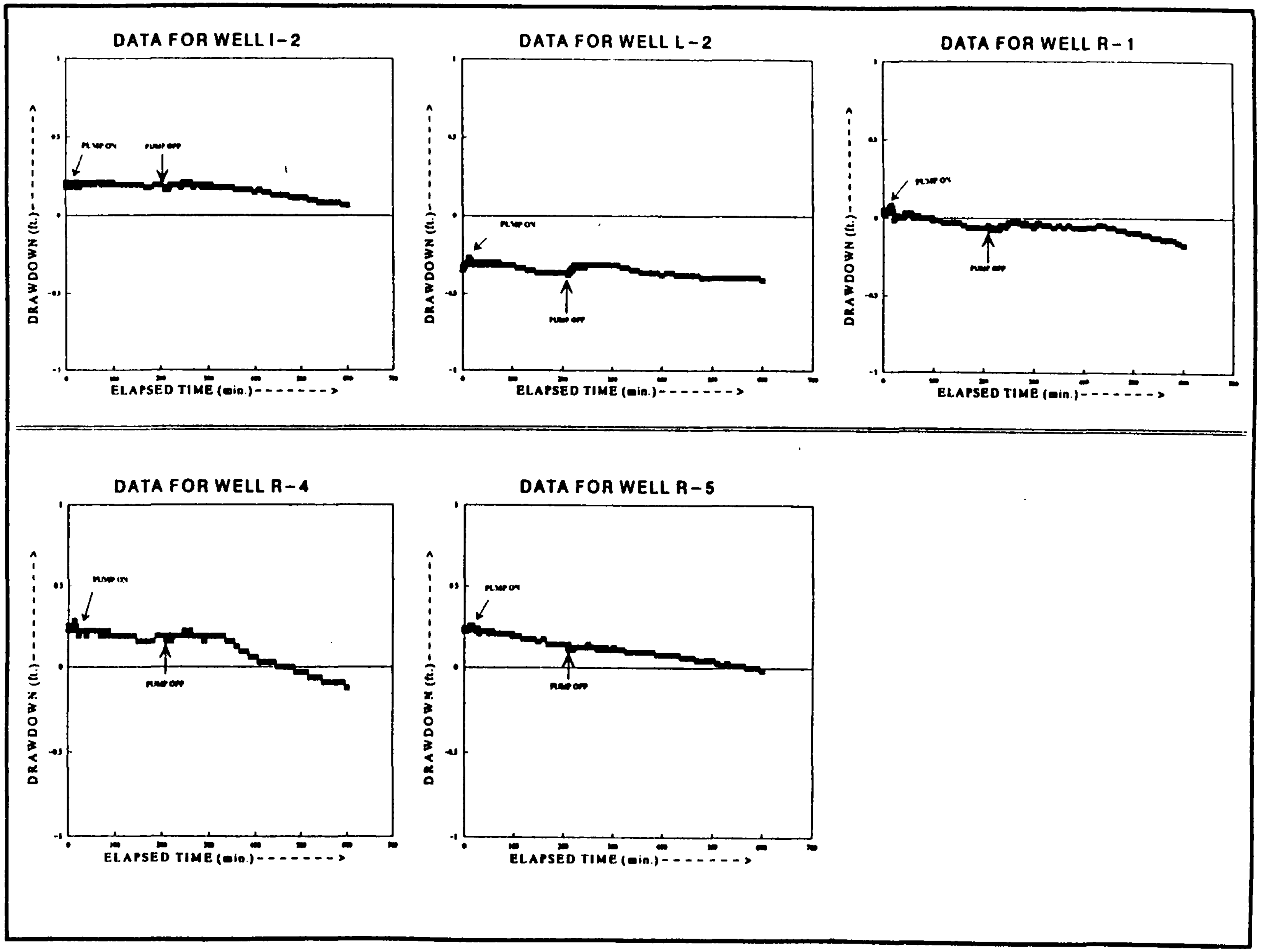

FIGURE 4-13 WATER LEVEL DRAWDOWN CURVES FOR THE OBSERVATION WELLS FOR TEST R-2, ZONE-2

sediments to migrate easily downward into the sandstone bedrock aquifer along the bedrock interface regardless of the integrity of the casing seat.

The hydrologic conditions at Well R-1 are similar to those at Well R-2. The total VOC concentration is relatively high (1,440 ppb), and there are 60 ft of shale and argillaceous sandstone overlying the highly permeable sandstone aquifer, which would naturally limit downward migration of groundwater from the unconsolidated sediments to the deeper sandstone aquifer. But, if the casing seal in Well R-1 is leaking as in Well R-2, it would induce downward migration of groundwater along the borehole to the sandstone bedrock aquifer.

4.2.3 Packer Testing Summary

A fairly thick (approximately 50 ft) permeable and laterally continuous sandstone exists in each well, which, in packer tests, contributed over 90% of the total yield in wells R-1 and R-2. Overlying the productive sandstone in wells R-1 and R-2 is a thick (52 to 62 ft) alternating sequence of low permeability shales and argillaceous sandstones, which collectively serves to reduce the groundwater flow from the overlying glacial deposits to the underlying sandstone bedrock. Erosion of the bedrock surface (during Quaternary glaciation) effectively removed the low permeability shales and argillaceous sandstones in the vicinity of Well R-4. As a result, the productive sandstone in Well R-4 is directly overlain by a thick sequence (approximately 89 ft) of unconsolidated glacial outwash deposits.

VOCs were detected in all five zones tested with concentrations ranging from 227 to 1,100 ppb. Static water level data from the zones tested during the packer tests indicated that a downward vertical gradient exists in wells R-1 and R-2. The falling head casing seal test results indicated that the casing seal is leaking in Well R-2 as a result of an uncemented annular space. This leaking seal provides a direct conduit for the migration of VOC from the overburden to the sandstone bedrock.

4.3 PUMP TESTING RESULTS

Short term constant rate pumping tests were conducted on five monitor wells (I-2, I-11, I-13, S-7 and S-11) in the area of EKCO during September 1991. Three of the tested wells (S-7, S-11, and I-2) are completed in the shallow sand and gravel. Well S-7 is also partially completed in the underlying clay, sand and gravel unit. The other two tested wells, I-11 and I-13, are completed in the deep sand and gravel glacial valley, which is the zone in which the OWS production wells are completed. The objective of the short term pumping tests was to evaluate transmissivity and hydraulic conductivity of the sand and gravel glacial deposits in the area of the site. The results of the pumping tests are summarized in Table 4-3, and the drawdown-recovery curves are in Appendix K.

The This recovery method (Kruseman and deRidder, 1991) was used to calculate the transmissivity from the recovery data for each test. Calculated transmissivity values ranged from 91 ft^2/day in well I-13 to 916 ft^2/ day in well S-11. The hydraulic conductivity for each tested zone was estimated by dividing the calculated transmissivity by the saturated thickness estimated from the geologic cross-sections. With the exception of well I-13 the hydraulic conductivity values ranged from 18 ft/day in well I-11 to 38 ft/day in well I-2, with an average hydraulic conductivity of 29 ft/day. The calculated hydraulic conductivity for well I-13 was one ft/day. This lower value may be due to an increased amount of clay present in the top 10 feet of the screened portion of well I-13. All of the calculated hydraulic conductivity values are within the typical range of values for sand (Freeze and Cherry, 1979). The results of these tests were used to calculate estimated rates of groundwater seepage velocity for the intermediate and deep sand and gravel glacial deposits, as discussed in Subsection 4.6.

4.4 SOIL SAMPLING RESULTS

WESTON performed soil investigations in 1988 and in 1991 to identify potential source areas and determine the extent of VOC contamination. The results of the 1988 investigation were presented in the Groundwater Quality Assessment Report (Appendix A) and are summarized below.

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Table 4-3

Pump Testing Results

Well	Q (gpm)	Transmissivity (ft^2 per day)	Estimated Saturated Thickness (ft)	Hydraulic Conductivity (ft/day)
I-2	9.7	384	10	38
I-11	27.5	625	35	18
I-13	27	91	85	1
S-7	17	229	10	29
S-11	9.1	916	30	30

4.4.1 Groundwater Quality Assessment Program Soil Boring Results

WESTON installed 14 soil borings in areas of potential VOC contamination. The location of these borings are indicated on Figure 3-4. The sampling results are presented in Table 4-4. TCE and 1,1,1-TCA were the primary VOCs detected. Total VOCs exceeding 1,000 μg/kg were detected in five borings. Based upon the soil boring samples, three areas contained elevated VOCs:

- Tank area at southwestern end of plant.
- Sump at production well W-10.
- Tank area at northern end of plant.

TCE was the primary constituent detected near the solvent storage tank. TCE contamination was concentrated in the shallowest sample. TCE was also the primary constituent detected in the soils immediately north of the building. A discussion on the 1988 Groundwater Quality Assessment soil boring and soil gas sampling is included in Appendix A.

4.4.2 RFI Soil Boring Results

The RFI soil borings were located to evaluate the three source areas identified during the Groundwater Quality Assessment program in 1988.

Eleven soil borings were drilled around the EKCO plant and soil samples were analyzed for VOCs. One to three analytical samples were taken from discrete depths within each boring. The results of the soil analyses are listed in Table 4-5. Soil borings SB-5, SB-6, and SB-7, located at the southwestern end of the plant (see Figures 4-14 through 4-18), are associated with the TCE storage tank there, and were the first source identified for further evaluation in Subsection 1.1.2. Soil borings SB-9 and SB-10 are associated with the documented release TCE to the sump of groundwater production well W-10, which was the second area identified for further evaluation in Subsection 1.1.2. Soil borings SB-1, SB-2, and SB-11 are

Table 4-4

Volatile Organic Compound Soil Boring Results ($\mu g/kg$)
1988 Sampling Program

Sample Depth	Depth ft.	1,1-DCE	1,1-DCA	1,2-DCE	1,1,1-TCA	TCE	MeCl	Carbon Disulfide	Toluene	Acetone	Chloro-form	2-Butanone	1,1,2-TCA	1,1,2,2-PCE	Ethyl-benzene	Xylene	Benzene
SB-001	2-6	ND	ND	ND	ND	ND	29.0B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	5.0	5.0	34.0B	ND	2.0J	63.0B	2J	7.0JB	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	3.0J	3.0J	23.0B	ND	3.0J	45.0B	ND	6.0JB	ND	ND	ND	ND	ND
SB-002	2-4	ND	ND	ND	5	7	21.0B	ND	ND	29.0B	ND	3.0JB	ND	ND	ND	ND	ND
	8-10	ND	ND	ND	2J	10	20.0B	ND	ND	66.0B	ND	6.0JB	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	4J	5	19.0B	ND	ND	100B	ND	18.0B	ND	ND	ND	ND	ND
SB-003	2-4	ND	ND	15	ND	ND	45.0B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	4.0J	5.0J	12.0B	ND	ND	100B	ND	19.0B	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	3.0J	3.0J	17.0B	ND	ND	200B	ND	22.0B	ND	ND	ND	ND	ND
SB-004	4-6	ND	ND	ND	4.0J	5.0	11.0B	ND	ND	27.0B	ND	6.0JB	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	4.0J	18.0	10.0B	ND	ND	38.0B	ND	14.0B	ND	ND	ND	ND	ND
	12-14	ND	ND	ND	10.0	110	48.0	ND	5.0J	110	ND	24.0B	ND	ND	ND	ND	ND
SB-005	2-4	ND	ND	ND	36	130	73B	ND	5J	66B	ND	12B	ND	ND	ND	ND	ND
	D	ND	ND	ND	19	110	35B	ND	3J	100B	ND	22B	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	ND	30	8B	ND	ND	10JB	ND	3J	ND	ND	ND	ND	ND
	18-20	ND	ND	ND	10	38	8B	ND	ND	21B	ND	7JB	ND	ND	ND	ND	ND
SB-006	2-4	ND	ND	2.0J	6.0	110	29B	4.0J	ND	57B	ND	9.0J	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	54	470	54B	ND	ND	55B	ND	16B	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	19.0	460	11.0	ND	ND	46.0B	ND	ND	ND	ND	ND	ND	ND
	14-16	ND	ND	ND	11.0	10.0	11.0	ND	ND	41.0B	ND	7.0JB	ND	ND	ND	ND	ND
	16-18	ND	ND	ND	120	360	22.0	ND	ND	110B	ND	12.0	ND	ND	ND	ND	ND
	24-26	ND	ND	ND	30.0	67.0	14.0	ND	ND	95.0B	ND	13.0B	ND	ND	ND	ND	ND
		ND	ND	ND	16	4.0J	7.0	ND	ND	61B	ND	9.0JB	ND	ND	ND	ND	ND
SB-007	2-4	ND	ND	ND	72.0	810	26.0	ND	5.0J	37.0B	ND	5.0JB	6.0	3.0J	ND	ND	ND
	4-6	ND	ND	ND	120	2900	35.0	ND	9.0	66.0B	ND	23.0B	21.0	3.0J	2.0J	4.0J	ND
	8-10	ND	ND	ND	57	230	18.0	ND	6.0	95B	ND	18B	6.0	ND	ND	ND	ND
	10-12	ND	ND	ND	33.0	58.0	76.0B	ND	ND	84.0	ND	ND	ND	ND	ND	ND	ND
	12-14	ND	ND	ND	41.0	310	68.0B	ND	ND	120	ND	ND	ND	ND	ND	ND	ND
	14-16	ND	ND	ND	440	1600	87.0B	ND	ND	77.0	ND	ND	ND	ND	ND	ND	ND

Table 4-4

Volatile Organic Compound Soil Boring Results ($\mu g/kg$)
1988 Sampling Program
(Continued)

Sample Depth	Depth ft.	1,1-DCE	1,1-DCA	1,2-DCE	1,1,1-TCA	TCE	MeCl	Carbon Disulfide	Toluene	Acetone	Chloro-form	2-Butanone	1,1,2-TCA	1,1,2,2-PCE	Ethyl-benzene	Xylene	Benzene
SB-008	2-4	ND	ND	ND	17.0J	140	35.0B	ND	ND	21.0JB	ND	ND	ND	15.0J	ND	ND	ND
	6-8	ND	ND	320	83.0	260	90.0B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10-12	ND	ND	200	56.0	250	210B	ND	ND	380	ND	ND	ND	ND	ND	ND	ND
	D	ND	ND	ND	ND	580	51.0B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-009	2-4	ND	ND	320	970	87.0	26.0JB	ND	ND	42.0J	ND	ND	ND	48.0	ND	ND	ND
	6-8	41.0	100	24.0J	ND	ND	81.0B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	12-14	ND	ND	ND	71.0	ND	210B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-010	2-4	ND	ND	ND	ND	48	110B	ND	ND	69B	ND	ND	ND	ND	ND	ND	ND
	4-6	ND	ND	21J	ND	200	120B	ND	ND	97B	ND	ND	ND	ND	ND	ND	ND
	8-10	ND	ND	360	ND	130	150B	ND	ND	150B	ND	ND	ND	ND	ND	ND	ND
SB-011	2-4	120	340	950	4000	12000	73B	ND	ND	73B	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	120	900	62	89000	300B	ND	ND	360B	ND	ND	ND	ND	ND	ND	ND
	8-10	ND	30	400	36	22000	220B	ND	ND	360B	ND	ND	ND	ND	ND	ND	ND
SB-012	2-4	ND	ND	ND	56	120	310B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4-6	ND	ND	ND	88	53	380B	ND	ND	390B	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	100	ND	600B	ND	ND	340B	ND	ND	ND	ND	ND	ND	ND
SB-013	2-4	ND	ND	ND	140	140000	460B	ND	28.0	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	ND	150	50.0B	ND	ND	67.0	ND	ND	ND	ND	ND	ND	ND
	10-12	ND	110	ND	36.0	70.0	260B	35.0	16.0	150B	27.0	ND	ND	ND	ND	ND	2.0J
SB-014	2-4	ND	ND	ND	ND	16.0	42.0	ND	ND	81.0B	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	ND	ND	9.0B	ND	ND	190	ND	ND	ND	ND	ND	ND	ND
	8-10	ND	ND	ND	ND	ND	12.0B	ND	ND	220	ND	ND	ND	ND	ND	ND	ND

Notes: ND = Not detected.
B = Analyte found in the blank.
J = Analyte detected at a concentration below the detection limit.

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Table 4-5

RFI Volatile Organic Compound Soil Boring Results (μg/kg) 1991 Sampling Program

Sample	Depth feet	1,1-DCE	1,1-DCA	1,2-DCE	1,1,1-TCA	TCE	MeCl	Carbon-disulfide	Toluene
SB-1	2-4	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	ND	44	ND	ND	ND
	10-12	ND	ND	13	9	160	ND	ND	ND
SB-2	2-4	ND	10	9	ND	ND	ND	ND	ND
	6-8	ND	ND	8	ND	13	ND	ND	ND
	10-12	ND	ND	ND	ND	ND	ND	ND	ND
SB-3	2-4	ND	ND	77	ND	42	ND	ND	ND
	6-8	ND	ND	12	ND	7	ND	ND	ND
SB-4	2-4	ND	ND	ND	ND	19	7BJ	ND	ND
	6-8	ND	14	27	10	18	ND	ND	ND
	10-12	7	82	300	31	630	8	ND	ND
SB-5	2-4	ND	10	22	ND	18	ND	ND	ND
	4-6	ND	17	69	26	130	ND	ND	ND
SB-6	6-8	14	37	570	48	2000	ND	30	ND
SB-7	0-2	ND	ND	210	ND	210	ND	ND	ND
	4-6	ND	ND	31	ND	140	ND	ND	ND
SB-8	0-8	ND	ND	210	ND	210	ND	ND	ND
	2-4	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	ND	ND	ND	ND	ND
	10-12	ND	ND	ND	ND	ND	ND	ND	ND
SB-9	2-4	ND	ND	ND	ND	ND	ND	ND	ND
	6-8	ND	ND	ND	ND	ND	ND	ND	34
	10-12	ND	11	160	ND	9	ND	ND	110
SB-10	0-2	ND	ND	ND	ND	34	ND	ND	ND
	6-8	ND	27	340	17	170	ND	ND	ND
SB-11	2-4	ND	ND	9	ND	ND	ND	ND	ND
	6-8	ND	ND	20	ND	17	ND	ND	ND
	10-12	140	340	3400	450	35	ND	12	200

Note: ND = Not detected.

associated with an abandoned solvent tank used in the past for the storage of TCE, and were the third source area identified in Subsection 1.1.2.

The soil boring analytical results indicated that all of the VOC soil concentrations were below 1,000 µg/kg except in two borings — SB-6, southwest of the plant, and boring SB-11 in the northeastern corner of the plant. Boring SB-6 contained 2,000 µg/kg of TCE, and boring SB-11 contained 34,000 µg/kg of 1,2-DCE. VOCs were detected in all of the soil borings except for boring SB-8 south of the plant. In eight of the 11 borings, the VOC concentrations increased with depth. However, in borings SB-2 and SB-3 northeast of the plant and boring SB-7 southwest of the plant, the VOC concentration decreased with depth. These results indicate that the VOCs in the area near borings SB-2, SB-3 and SB-7 are probably from a relatively more recent source than the other areas; however, it is not possible to quantify precisely when the releases may have occurred from these results.

Most of the VOC compounds detected are members of the chlorinated ethene group (TCE, 1,1-DCE and 1,2-DCE) and the chlorinated ethane group (1,1,1-TCA and 1,1,1-DCA). Figures 4-14 through 4-18 display the concentrations of these five compounds. This figure shows that TCE was detected in all borings except SB-8, and the concentrations increased with depth in all borings except SB-2, SB-3 and SB-7. The highest TCE concentration (2000 µg/kg) was found southwest of the plant in SB-6. Figure 4-15 shows that 1,1-DCE was detected in only two borings (SB-4 and SB-6) at concentrations of 7 µg/kg and 14 µg/kg, respectively. Figure 4-16 shows that 1,2-DCE was found in all the borings except in boring SB-8, and the concentration increased with depth in all borings except SB-2, SB-3 and SB-7. The highest 1,2-DCE concentration (34,000 µg/kg) was found in the northeast corner of the plant in boring SB-11.

The analytical sampling results indicated that the concentrations of the chlorinated ethanes were lower than the chlorinated ethenes. In addition, the chlorinated ethanes were detected in deeper samples and were not detected at the surface. This indicates that there probably have not been recent releases of 1,1,1-TCA in the areas of the 11 borings. Figure 4-17 shows that 1,1,1-TCA was detected in six of the 11 borings (SB-1, -4, -5, -6, -10 and -11), and

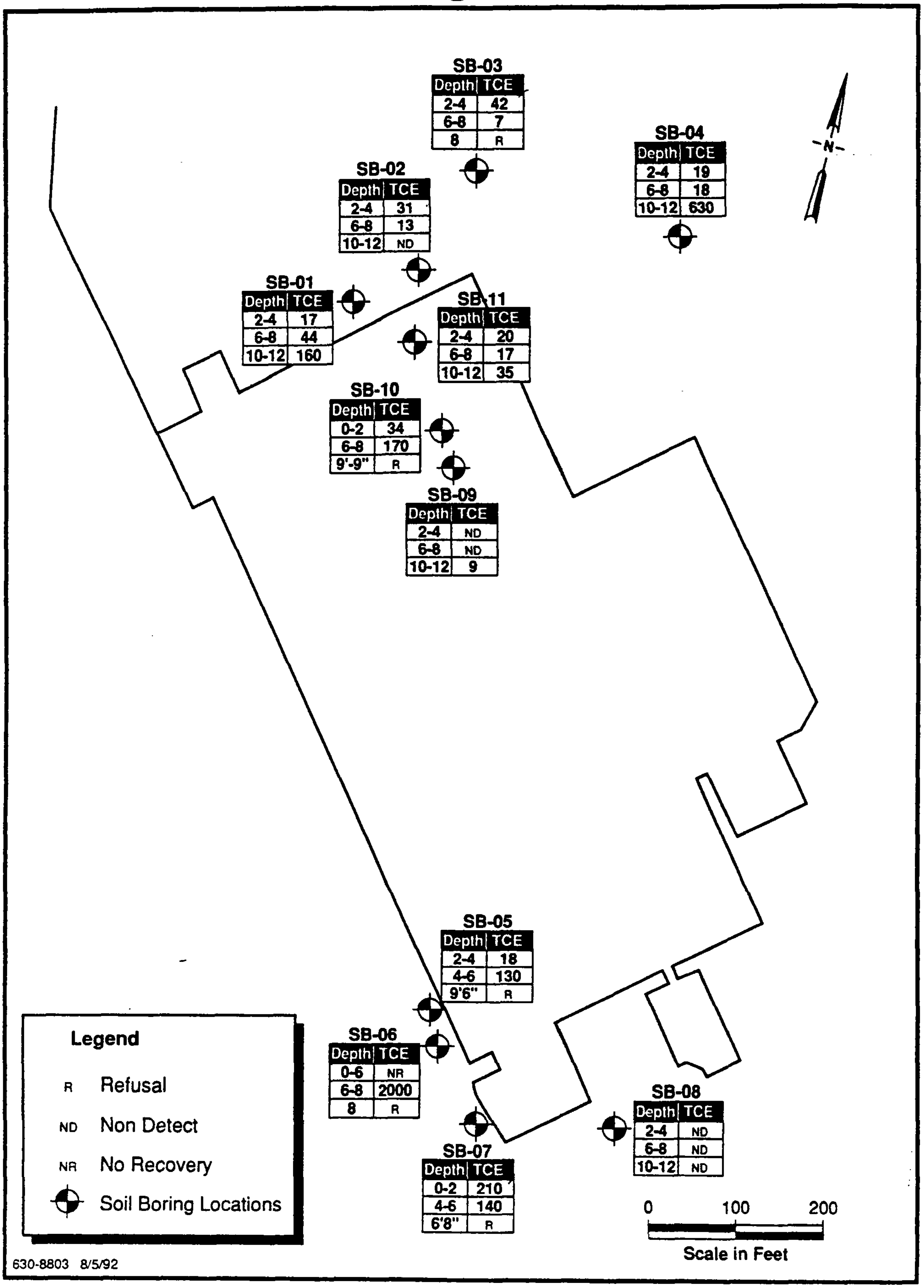

FIGURE 4-14 TRICHLOROETHENE (TCE) CONCENTRATIONS (ug/kg) IN SOIL BORING SAMPLES

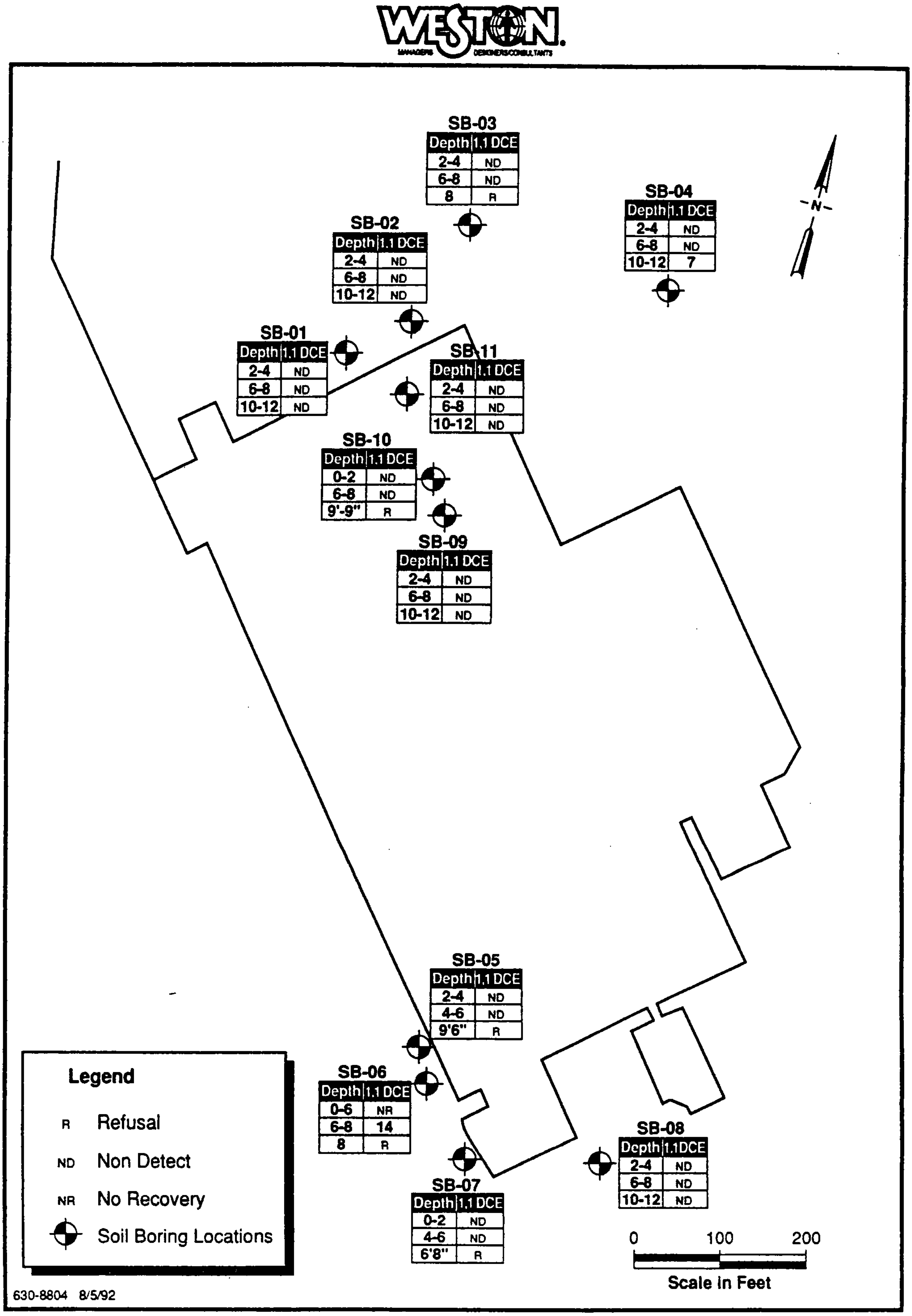

FIGURE 4-15 1,1 DICHLOROETHENE (1,1-DCE) CONCENTRATIONS (ug/kg) IN SOIL BORING SAMPLES

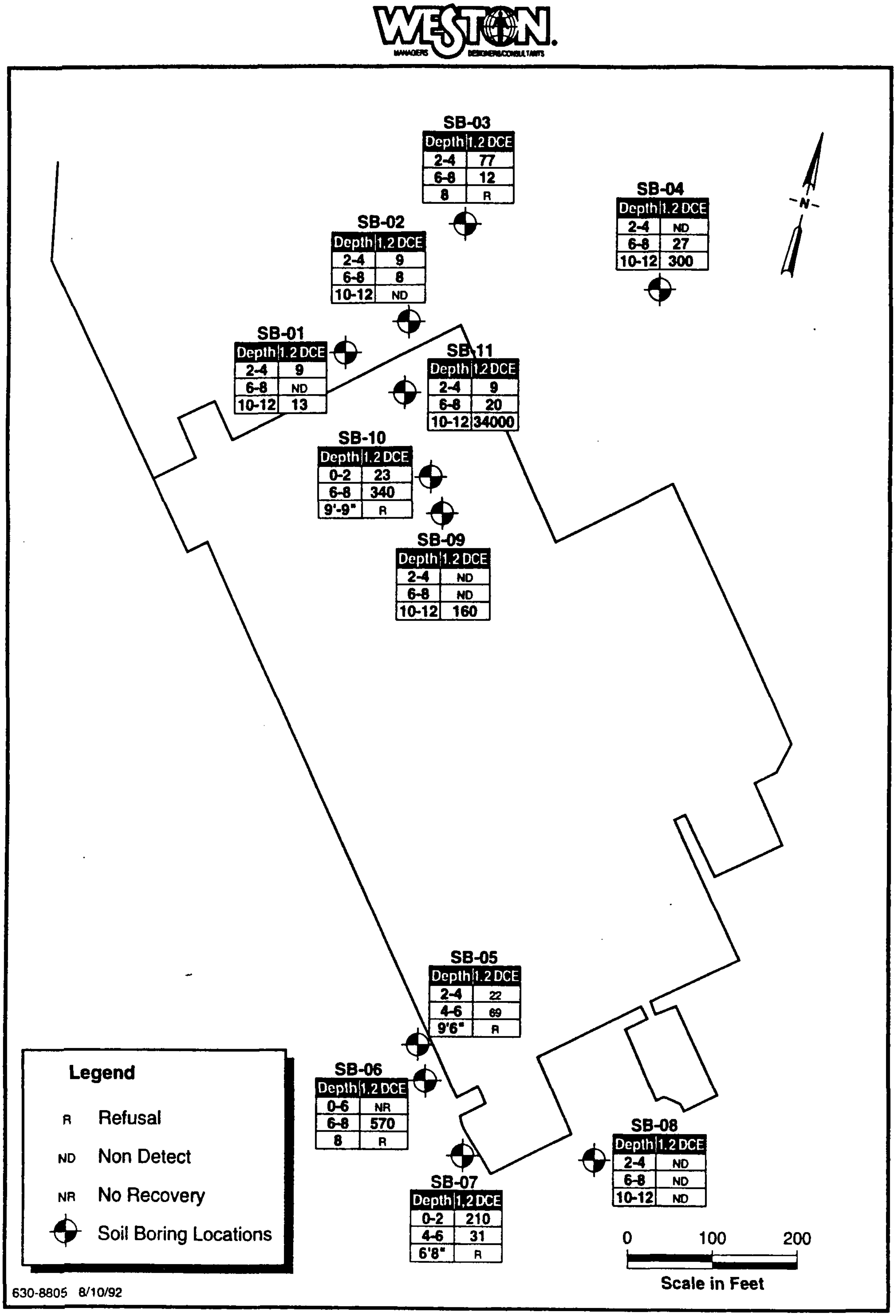

FIGURE 4-16 1,2 DICHLOROETHENE (1,2-DCE) CONCENTRATIONS (ug/kg) IN SOIL BORING SAMPLES

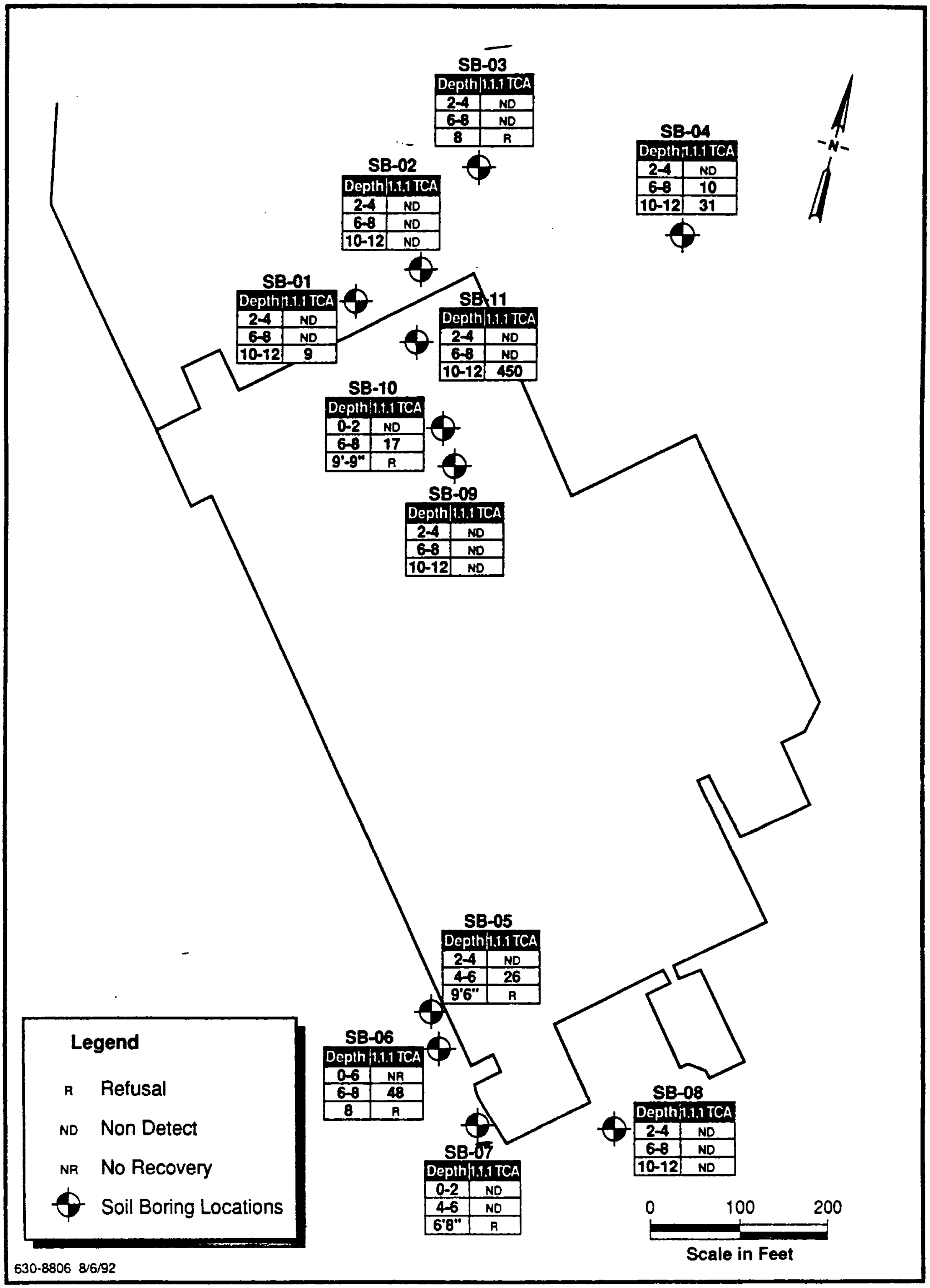

FIGURE 4-17 1,1,1 TRICHLOROETHANE (1,1,1-TCA) CONCENTRATIONS (ug/kg) IN SOIL BORING SAMPLES

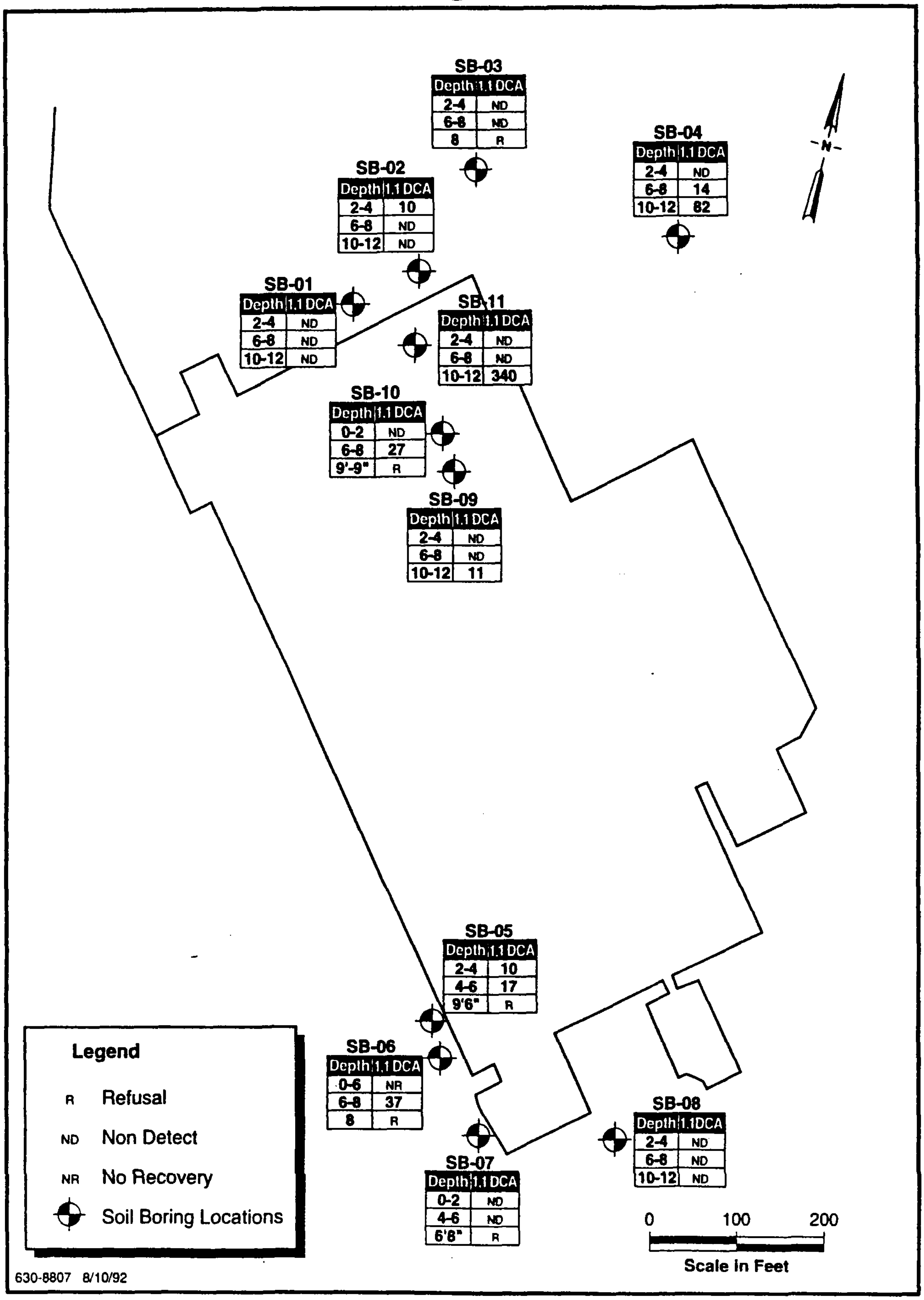

FIGURE 4-18 1,1 DICHLOROETHANE (1,1-DCA) CONCENTRATIONS (ug/kg) IN SOIL BORING SAMPLES that it was detected only at the bottom of these borings. The highest 1,1,1-TCA concentration (450 μg/kg) was found at the bottom of boring SB-11. The 1,1,1-TCA concentrations in the remainder of the borings were all below 50 μg/kg.

Figure 4-18 shows that 1,1-DCA was detected in six of the borings (SB-4, -5, -6, -9, -10 and -11) and it was predominately detected at the bottom of those borings. The highest 1,1-DCA concentration, 340 μg/kg, was found at the bottom of boring SB-11. The 1,1-DCA concentration in the rest of the borings were all below 100 μg/kg. In addition to the chlorinated ethenes and ethanes, three other compounds were detected: methylene chloride, carbon disulfide, and toluene. The concentrations of these compounds are listed on Table 4-5, and they were all at or below 200 μg/kg.

The VOC analytical results from the soil borings indicate that chlorinated ethene compounds are found at higher concentrations and more abundantly than chlorinated ethane compounds. The results indicate that while there do not appear to be recent 1,1,1-TCA sources in the areas of the 11 borings, there may be recent TCE sources near borings SB-2, -3, and -7. The soil boring sampling results indicated two areas of relatively higher concentrations of VOC, in the northeastern part of the plant at boring SB-11, and southwest of the plant near boring SB-6.

4.5 FACILITY GEOLOGY

The EKCO facility is situated on the western flank of a buried glacial valley. That valley extends to the north and south at least as far as Crystal Springs and Navarro, Ohio. The position of the buried valley is approximately coincident with the meander belt of the Tuscarawas River. The valley was carved from Pennsylvanian age sedimentary rocks during Pleistocene glaciation. The successive advance and retreat of various glacial ice lobes during the Pleistocene also resulted in the deposition of a wedge of clastic sediments within the valley, unconformably overlying the sedimentary bedrock. Prior to the construction of the facility in 1945, a cover of fill material was used to level the natural glacially-formed topography at the building site. Both the bedrock and unconsolidated sediments function as important water-bearing zones in the area of the EKCO property, and the fill material is predominately unsaturated.

A wedge of glacially-deposited sediments overlies the bedrock at the site. The sediments form a thin veneer of cover, less than 20 ft thick, in the western portion of the site where bedrock is shallow. In the eastern portion of the site, the sediments fill a glacial valley, reaching a maximum thickness of greater than 252 ft in monitor well borehole I-8D.

The glacial sediments consist of a series of interbedded permeable sand and gravel layers and lower permeability silt and clay layers with varying percentages of sand and gravel. Background information on the glacial geology of northeastern Ohio suggests that these sediments represent a complex interbedding of glacial tills and outwash sands deposited by several successive advances of glacial ice lobes. Based on the vertical distribution of the sediments encountered during drilling, seven separate layers have been identified and correlated among monitor wells at the facility. The layers that are identified represent general hydrostratigraphic units: layers of sediments which exhibit similar relative permeabilities. Three high permeability units have been identified, separated by four lower permeability units.

The distribution of these seven hydrostratigraphic layers across the site are illustrated in the five cross-sections of the subsurface (Figures 4-19 through 4-23). Cross sections 4-19 and 4-20 depict the vertical and horizontal sediment profile perpendicular to the axis of the glacial valley. Cross sections 4-21, 4-22, and 4-23 depict the sediment profile parallel to the glacial valley axis. A fence diagram (Figure 4-24) illustrates a three dimensional profile of the seven layers and monitor well zones. Collectively these subsurface profiles show that the seven layers are generally continuous across the site until each layer encounters bedrock. As a result of the gradual slope of the bedrock surface to the east, the uppermost units (the upper silt and clay, the upper sand and gravel, and the upper till) are encountered in all well boreholes while the deeper units (the deep sand and gravel and deep silt and clay) are only encountered in monitor well boreholes along the eastern site perimeter.

Each of these seven layers was encountered in monitor well I-8D, as shown in Figure 4-19. The three high permeability units are referred to as the shallow, intermediate and deep. The geology of each hydrostratigraphic unit is discussed below.

4.5.1 Shallow Geology

The high permeability shallow sand and gravel is overlain in some areas by low permeability fill materials and natural silt and clay. The fill, predating the EKCO facility, was used to level the site and covers the area north, east, and southeast of the plant building. The thickest cover (to 25 ft) is encountered in the vicinity and to the southeast of the surface impoundment. The fill deposits consist of a wide variety of materials ranging from construction debris to fly ash. At the surface the fill is a very hard, compacted material with low permeability. The fill is less compacted with depth. The upper silt and clay varies, grading from a sandy silt to a silty clay, and may contain gravel or organic material. This layer is thickest (20 ft) in monitor well borehole L-3, and it is the uppermost lower permeability unit.

The shallow unit is the uppermost sand and gravel, and it is the most variable of the permeable sand and gravel units encountered at the site. It varies from a fine to medium sand with lesser percentages of gravel and silt to a coarse sand with gravel. This unit is thickest at the eastern perimeter of EKCO (approximately 25 ft in monitor well I-11) and pinches out to the west along the bedrock high (monitor wells L-3 and W-1). The high permeability shallow sand and gravel is directly underlain by the upper till (clay, sand, gravel), which varies in texture between a stiff sandy, silty clay to a poorly sorted, noncohesive gravel in a sand and clay matrix. The upper till is thickest (20 ft in monitor well I-6) in the southern part of the site and pinches out on the northwestern portion along the bedrock high. This unit probably has a variable permeability across the site but in general is of lower permeability than the three sand and gravel units.

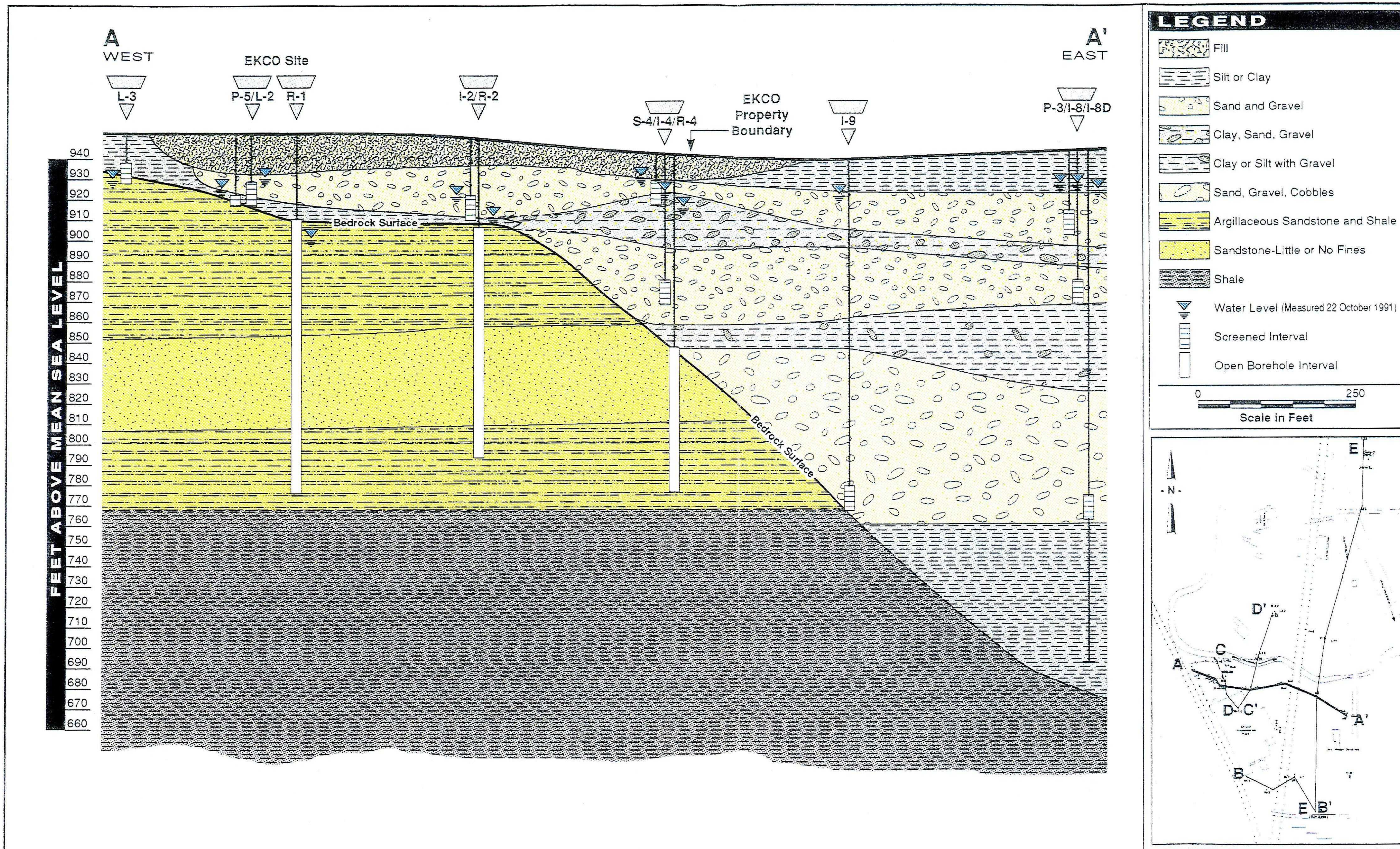

FIGURE 4-19
GEOLOGIC CROSS SECTION A-A'
AT EKCO THE HOUSEWARES PLANT, MASSILLON

622-8678 5/11/93

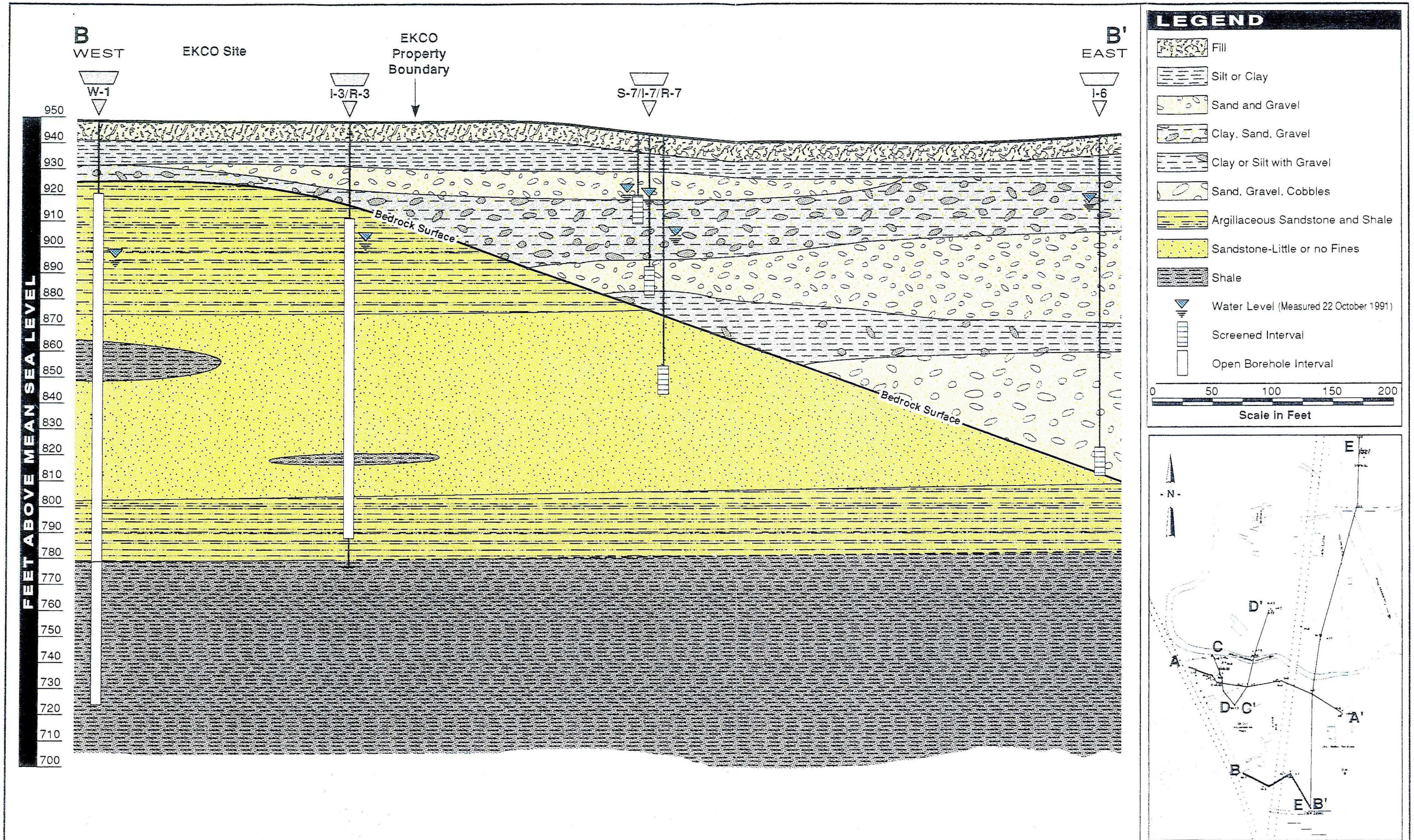

FIGURE 4-20
GEOLOGIC CROSS SECTION B-B'
AT EKCO THE HOUSEWARES PLANT,
MASSILLON

622-8679 5/11/92

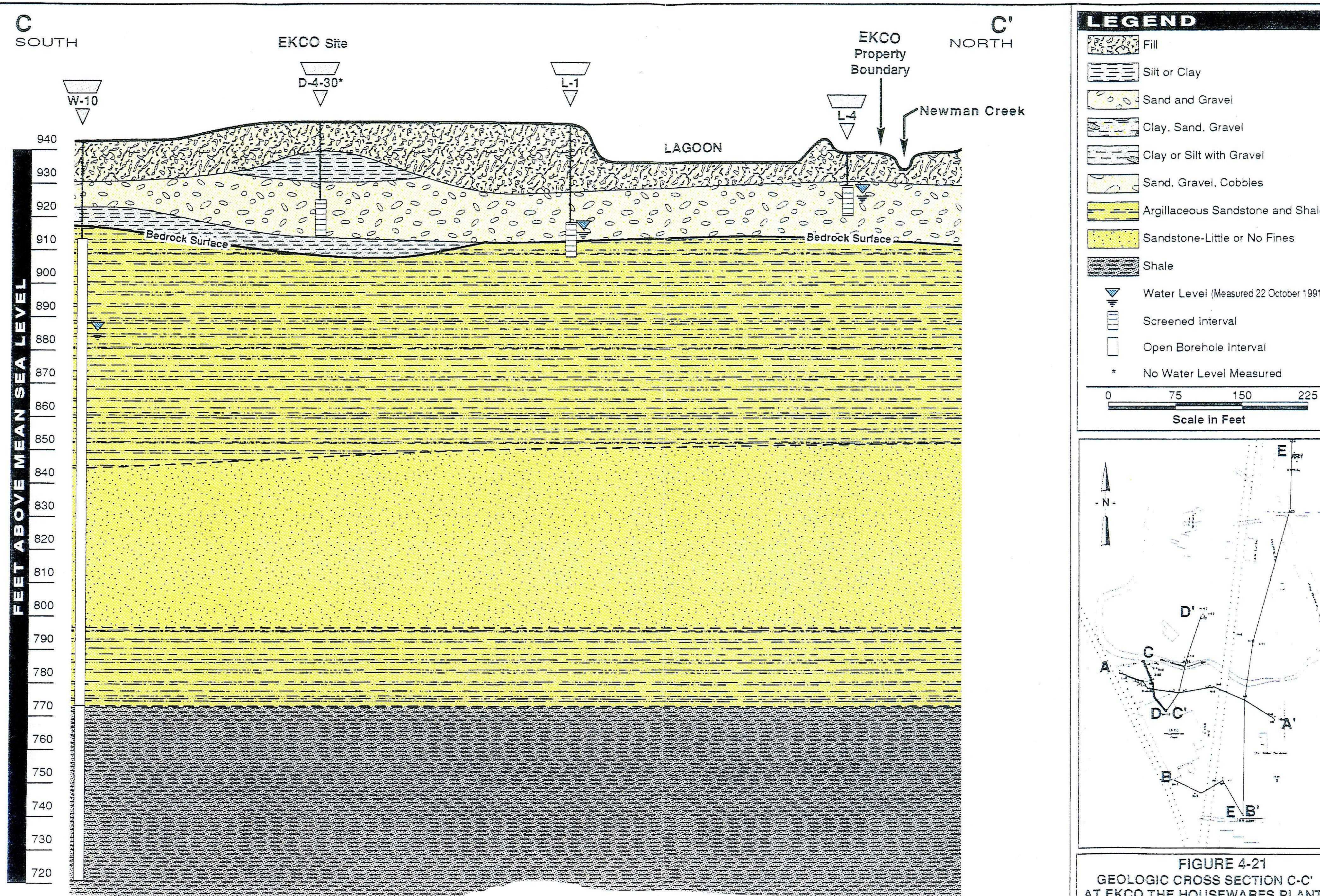

FIGURE 4-21
GEOLOGIC CROSS SECTION C-C'
AT EKCO THE HOUSEWARES PLANT,
MASSILLON

623-8680 5/11/93

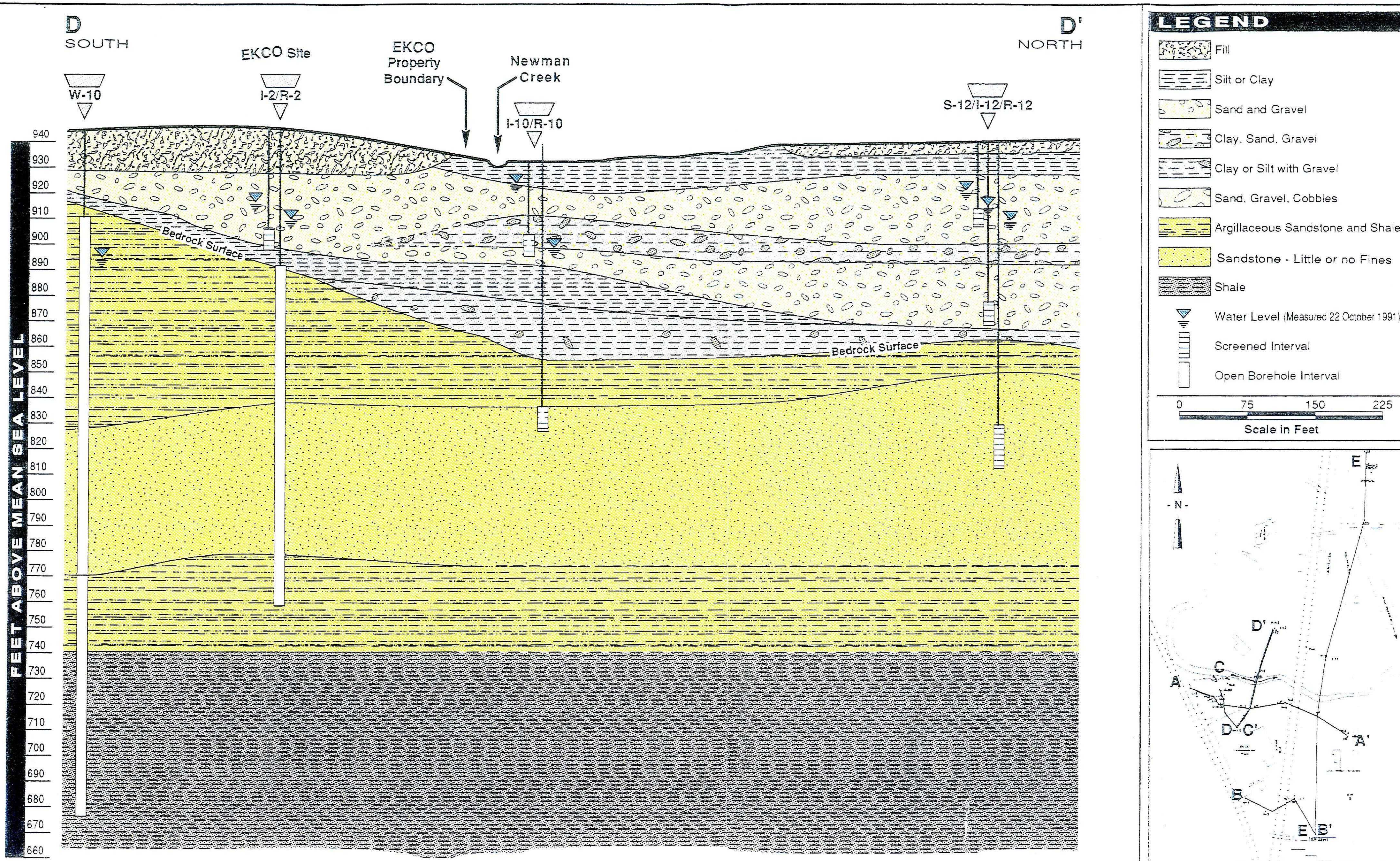

FIGURE 4-22
GEOLOGIC CROSS SECTION D-D'
AT EKCO THE HOUSEWARES PLANT,
MASSILLON

623-8681

5/11/93

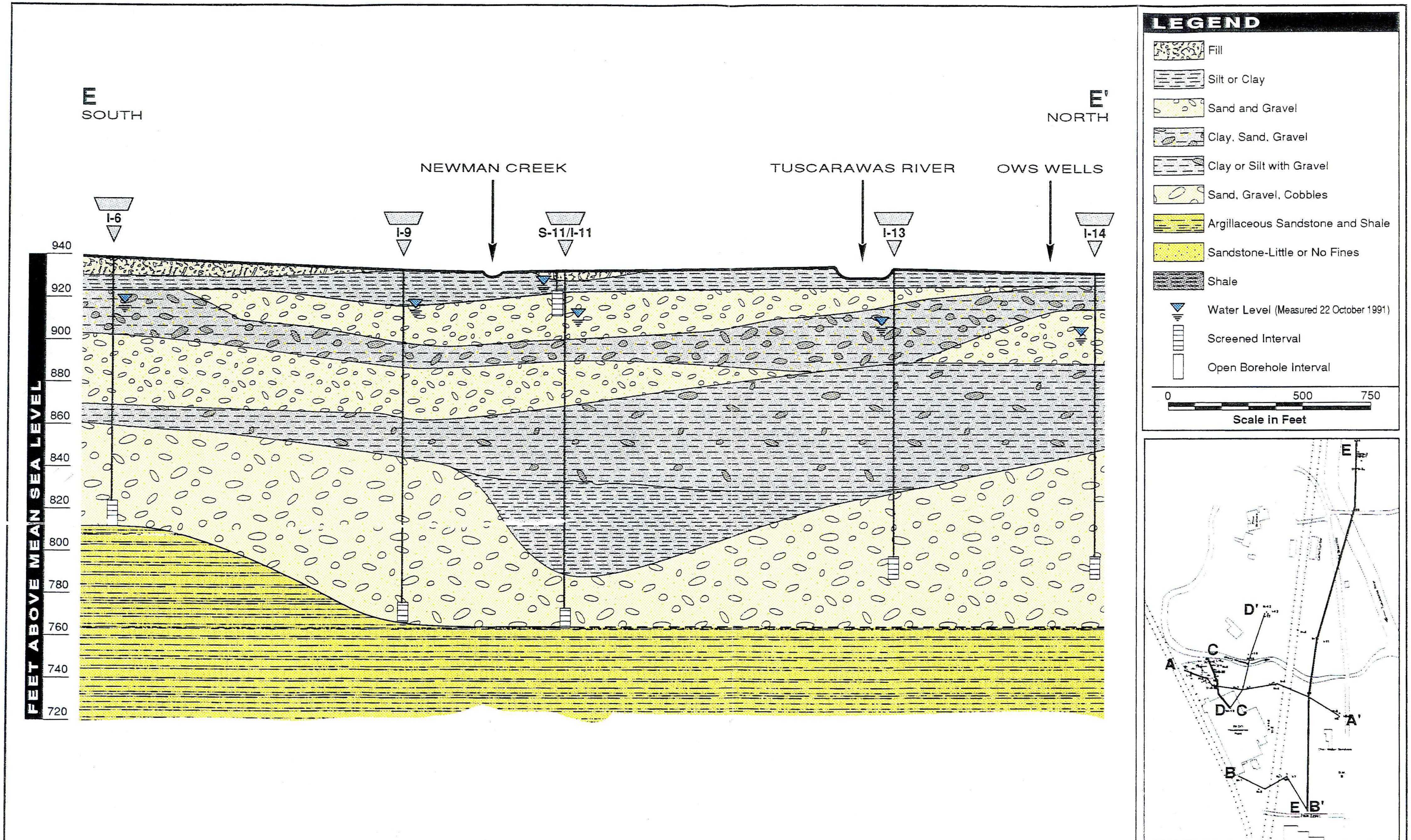

FIGURE 4-23
GEOLOGIC CROSS SECTION E-E'
AT EKCO THE HOUSEWARES PLANT,
MASSILLON

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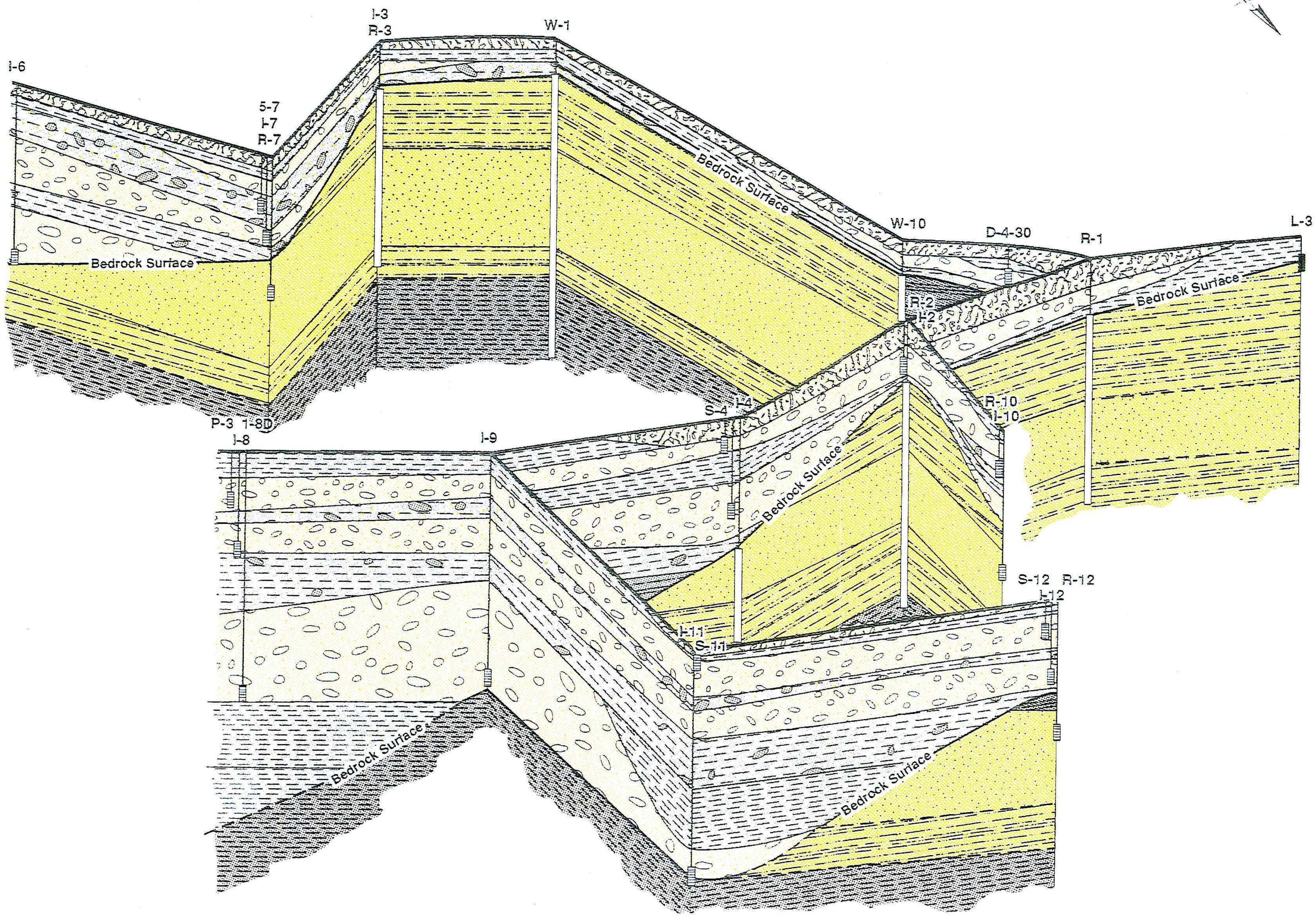

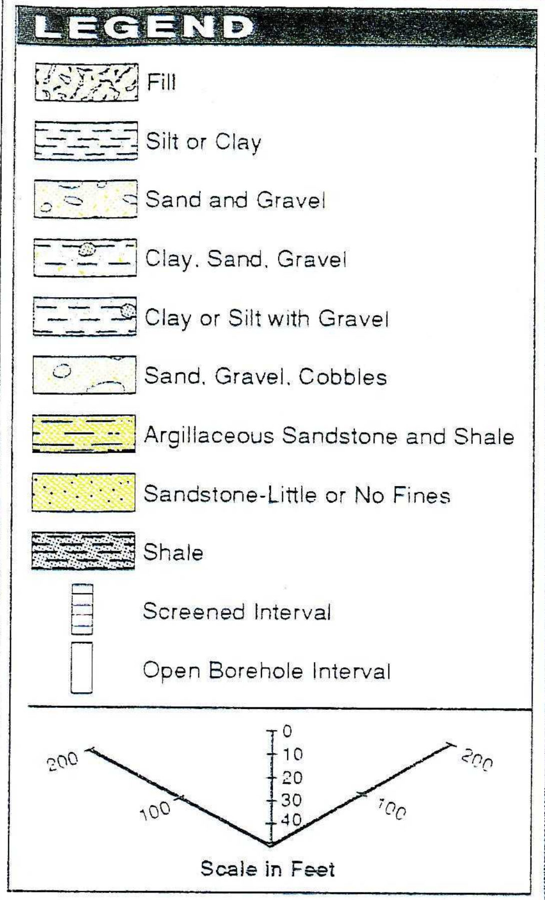

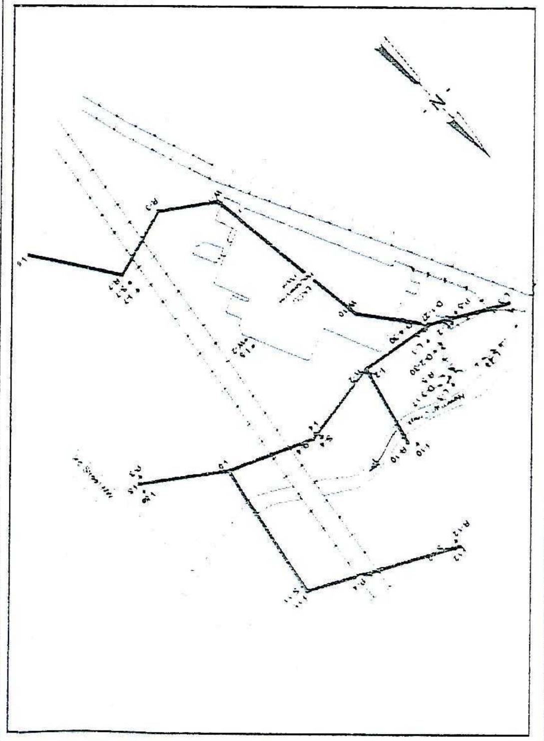

FIGURE 4-24
FENCE DIAGRAM
AT EKCO THE HOUSEWARES PLANT,
MASSILLON

624-8689 5/11/93

4.5.2 Intermediate Geology

The intermediate sand and gravel is a slightly coarser sand and gravel mixture than the upper unit. It is variable in texture from a fine- to medium-grained sand with 30% pebbles to a gravel (cobbles to 4 inches) in a fine- to coarse-grained sand matrix. This unit is thickest (35 ft) in monitor well I-4 and is truncated by the bedrock surface along the western site boundary.

It is directly underlain by the intermediate till (clay and silt with gravel) which, in general, is finer-grained and less permeable than the upper till unit. This unit varies in texture from a sandy clay to a silt with 10 to 25% gravel. This unit is thickest (42 ft) in monitor well I-8D and is truncated by the bedrock surface along the western site boundary.

4.5.3 Deep Geology

The deep sand and gravel is the coarsest sand and gravel unit. It varies from a medium-grained sand with a lesser percentage of silt and gravel to cobbles (up to 6-inches) in a coarse-grained sand matrix. This unit is thickest in monitor well I-9 (75 ft) and is encountered only in the eastern perimeter monitor wells.

It is directly underlain by the deep silt and clay which is a very low permeability unit encountered only in monitor wells I-8D and I-11. This unit varies from a clay with lesser percentages of silt and sand and a trace of gravel to a firm silt with a trace of gravel. Seventy feet of this unit was encountered at the base of monitor well I-8D.

4.5.4 Bedrock Geology

The bedrock topography, correlated from monitor well boreholes drilled at the EKCO site, is shown in Figure 4-25. From west to east, the bedrock surface slopes at an approximate 17° angle, representing a difference in elevation across the property of approximately 280 ft. The bedrock is encountered at its highest elevation, 930 ft MSL, in monitor well L-3 on

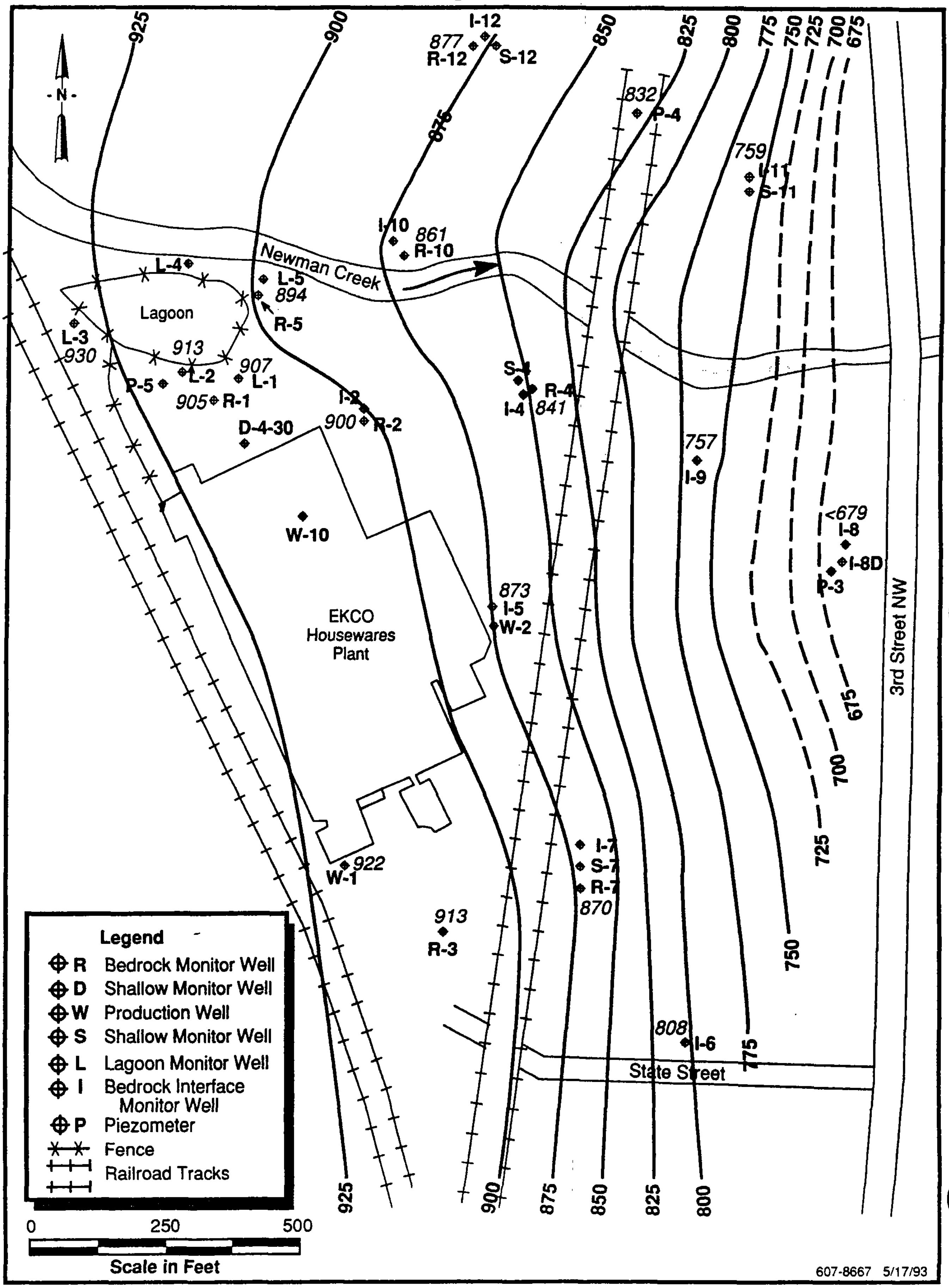

FIGURE 4-25 BEDROCK ELEVATION CONTOUR MAP

the northwestern perimeter of the property. In the eastern portion of the site, the bedrock surface was projected to occur at approximately 679 ft MSL, based on lithologic information obtained from monitor well borehole I-8D.

Bedrock encountered at the site consists of four interbedded shale, argillaceous sandstone, and sandstone units representative of the Pennsylvanian age Pottsville group. Because the regional dip of the beds is gradual, approximately 0.3° to the southeast, the elevation of the contact between each bed is consistent across the facility.

An interbedded shale and argillaceous sandstone is the shallowest bedrock unit encountered. As shown in Figure 4-19, the base of this unit has an approximate elevation of 850 ft above mean sea level (MSL) in monitor wells installed in the western portion of the site. As indicated by the interpretation of geophysical logs of monitor well boreholes R-1, R-2, and R-4, the shales and sandstones vary between two and 10 feet in thickness. The sandstones in this unit are described as fine-grained with a significant silt and clay content. These argillaceous sandstones coupled with the shale interbeds have a low permeability relative to the underlying sandstone unit.

A well-sorted, medium to coarse-grained sandstone underlies the upper interbedded shale and sandstone. This approximate 50-ft sandstone unit is encountered between 850- and 800-ft MSL in all bedrock wells at the site. Interpretation of geophysical logs indicates that this unit is permeable relative to the other bedrock units encountered at the site. This sandstone bedrock unit is the primary medium for groundwater flow and chemical transport in the bedrock. The fine-grained shale and argillaceous flow have a low permeability and in general act as aquitards for groundwater flow and chemical transport. However, limited fracturing may increase permeability in some areas.

A second interbedded shale and argillaceous sandstone unit underlies the sandstone. As shown in Figures 4-20 and 4-22, this approximate 20-ft-thick unit was encountered in monitor wells W-1 and W-10 between 800 and 780 ft MSL. Like the first unit, this interbedded shale and sandstone consists of two to 10 foot thick beds with a relative low permeability.

The fourth bedrock unit encountered at the site is a thinly-bedded shale. As shown in Figures 4-20 and 4-22, the top of this unit was encountered at 780 ft MSL; the base of the unit was not penetrated in any on-site well. The shale is at a minimum 60 ft thick.

4.6 FACILITY HYDROGEOLOGY

The vertical stratigraphy of the site is divided into four distinct permeable hydrostatigraphic units: shallow sand and gravel; intermediate sand and gravel, deep sand and gravel, and sandstone bedrock. The sand and gravel units are separated by low permeability clay and silt layers. In general, the sand and gravel units act as the primary media for groundwater flow and chemical transport. The less permeable silt, clay and fill material typically act as barriers to groundwater flow, however, variations in permeability occur locally.

The sediments form a thin veneer of cover, less than 20 ft thick, in the western portion of the site where bedrock is shallow. In the eastern portion of the site, the sediments fill a glacial valley, reaching a maximum thickness of greater than 280 ft in well I-8D. Three OWS production wells (OWS-1, -2, and -3) completed in the deep sand and gravel zone produce up to 2,000 gpm.

There are 35 wells at and around the facility that have been used to acquire water level and water quality data. Each of these wells monitors conditions in one of the four hydrostratigraphic units discussed above. There are 12 wells that monitor the shallow unit, i.e., L-1 through L-5, S-4, S-7, S-11, S-12, D-4-30, P-3, and I-2. Seven wells monitor the intermediate unit, I-2, I-4, I-5, I-7, I-8, I-10, and I-12. Well I-2 may monitor conditions in both the shallow and intermediate unit because the confining clay layer may not be present in the area north of Well I-2, and both water bearing zones may converge. Six wells monitor the deep unit, i.e., I-6, I-8D, I-9, I-11, I-13, and I-14. There are 11 wells that monitor the bedrock zone; R-1 through R-5, R-7, R-10, R-12, W-1, W-2, and W-10. The hydrogeologic conditions of these four hydrostratigraphic zones are discussed below.

4.6.1 Shallow Hydrogeology

Seven of the shallow wells (L-1 through L-5, S-4, and D-4-30) are screened in low permeability fine grained sediments and fill. The other five shallow wells are screened in higher permeability sand and gravel sediments. Figure 4-26 displays a contour map of shallow groundwater developed from water levels measured on 22 October 1991. Water levels for wells S-7, S-11, S-12, and P-3 were posted on the map but were not contoured because of limited data in those particular areas. Most of the shallow wells are located north and northeast of the EKCO plant. Groundwater contours in this area show that there is a groundwater gradient toward the plant facility and production well W-10, and that Newman Creek represents a shallow groundwater divide in the area of the site. This concentric drawdown cone is most likely caused by the pumping of the two recovery wells, W-1 and W-10, which pump continuously at approximately 245 and 350 gpm. The figure shows an area on the west side of the site where the entire shallow zone is unsaturated. The extent of the shallow unsaturated zone was estimated by comparing the top of bedrock elevation (Figure 4-25) with the shallow groundwater elevation. The shallow zone was considered to be totally unsaturated (dewatered) where the top of bedrock elevation (and bottom of the shallow zone) was higher than the estimated shallow groundwater elevation. This dewatered condition was confirmed by the borehole for interface well I-3 which was drilled adjacent to well R-3 and was dry. This area of dewatered shallow material is probably caused by the combination of a thin saturated thickness and the drawdown caused by production wells W-1 and W-10. The groundwater flow direction arrows figure show that the shallow groundwater at the site is flowing toward the production wells W-1 and W-10.

There is a 14.25-ft drop in groundwater elevation from Well L-4, which is at the northern edge of the site and adjacent to Newman Creek, to Well L-1, which is the closest shallow well to production well W-10. The average groundwater gradient was calculated from Well

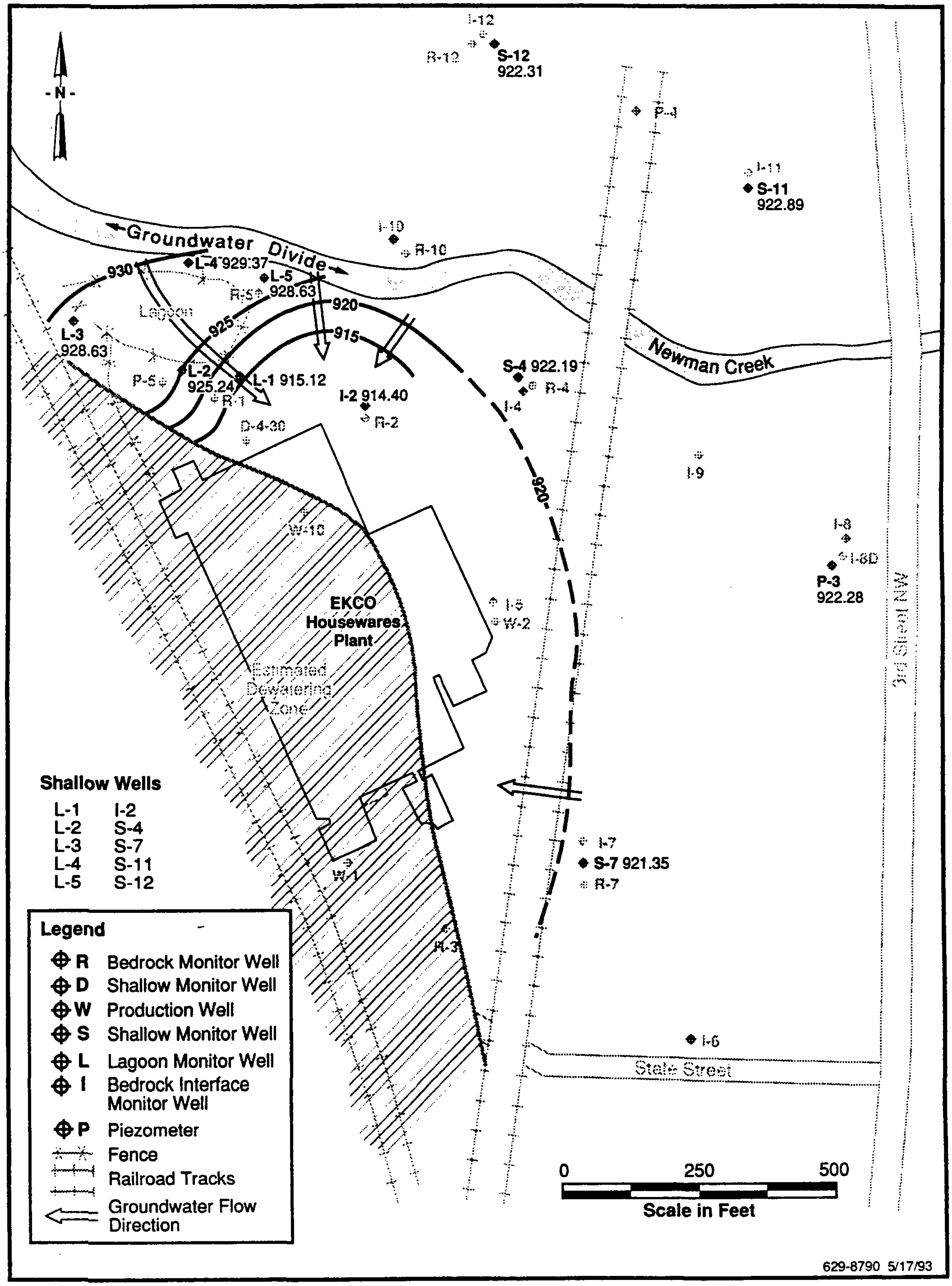

FIGURE 4-26 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE SHALLOW SAND AND GRAVEL WATER BEARING ZONE, WATER LEVELS MEASURED 22 OCTOBER 1991

L-4 to Well L-1 by dividing the head difference by the distance between these two wells. The calculated average gradient was 0.071 ft/ft. The figure shows that the gradient increases toward the production well W-10, which is typical of a drawdown cone around a pumping well. The horizontal groundwater gradient is the primary driving mechanism for groundwater flow in a porous medium.

The average groundwater seepage velocity for the shallow water-bearing unit in the area north of the EKCO plant was calculated to be 0.5 ft/day by using the hydrologic parameters and the seepage velocity form of Darcy's Law listed below:

$$v_s = Ki/\eta e$$

Where:	v_s	= seepage velocity;	=	0.5 ft/day
	K	= hydraulic conductivity	=	1 ft/day
	i	= groundwater gradient, dh/dl	=	0.071 ft/ft
	ηe	= effective porosity	=	15%

The hydraulic conductivity was an estimated value (Freeze and Cherry, 1979) for a silty sand material, which is typical of the material found in the geologic logs for the area north of the EKCO plant. The effective porosity was also an estimated value (Walton, 1985). The groundwater velocity varies as the hydrologic parameters vary but this value is meant to be an order of magnitude estimate for conditions in the shallow fine grained material north of the plant. The calculated groundwater gradient and seepage velocity are influenced by the pumping of production well W-10 and values for non-pumping conditions would be different. However, these values represent the hydrologic conditions which currently exist at the site. The hydrologic conditions of the other three hydrostratigraphic zones at the site are discussed below, and the interrelationship of the zones are discussed in Subsection 4.6.5.

4.6.2 Intermediate Hydrogeology

The intermediate zone generally consists of permeable sand and gravel with some silt and it is monitored by seven wells in the area of the facility. This unit is thickest in well I-4 and is truncated by the bedrock surface along the western portion of the site. The intermediate zone is overlain by the upper till, a low permeable clay, sand and gravel. Figure 4-27 displays an intermediate groundwater contour map of water levels measured on 22 October 1991. The figure shows that, like the shallow zone, the intermediate zone exhibits groundwater flow toward production wells W-1 and W-10. The figure also shows that there is an intermediate zone groundwater divide in the area of Newman Creek. South of the creek the groundwater flows south and southwest toward the production wells, and north of the creek the intermediate zone groundwater flows to the north and northeast. These conditions are probably caused by the pumping of the site production wells. The groundwater flow direction arrows on the figure show that the intermediate groundwater at the site is flowing toward the production wells W-1 and W-10.

There is an 8.7 ft drop in groundwater elevation from Well I-10 at the northern property border to Well I-2, which is the closest intermediate zone well to production well W-10. The average groundwater gradient for the intermediate zone was calculated from Well I-10 to Well I-2 by dividing the head difference by the distance between these two wells. The calculated average gradient was 0.033 ft/ft. A less steep gradient exists in the intermediate zone east of the site between wells I-8 and I-7.

The average groundwater seepage velocity for the intermediate water bearing zone in the area of the site was calculated to be 6.6 ft/day by using the hydrologic parameters and the seepage velocity form of Darcy's Law listed below:

$$v_s = Ki/\eta e$$

where:	v_s	=	seepage velocity;	=	6.6 ft/day
	K	=	hydraulic conductivity	=	29 ft/day
	i	=	groundwater gradient, dh/dl	=	0.033 ft/ft
	ηe	=	effective porosity	=	15%

The hydraulic conductivity was estimated from the results of the short term pumping test recovery data, and the effective porosity was estimated (Walton, 1985). The calculated groundwater gradient and seepage velocity are influenced by the pumping of the production

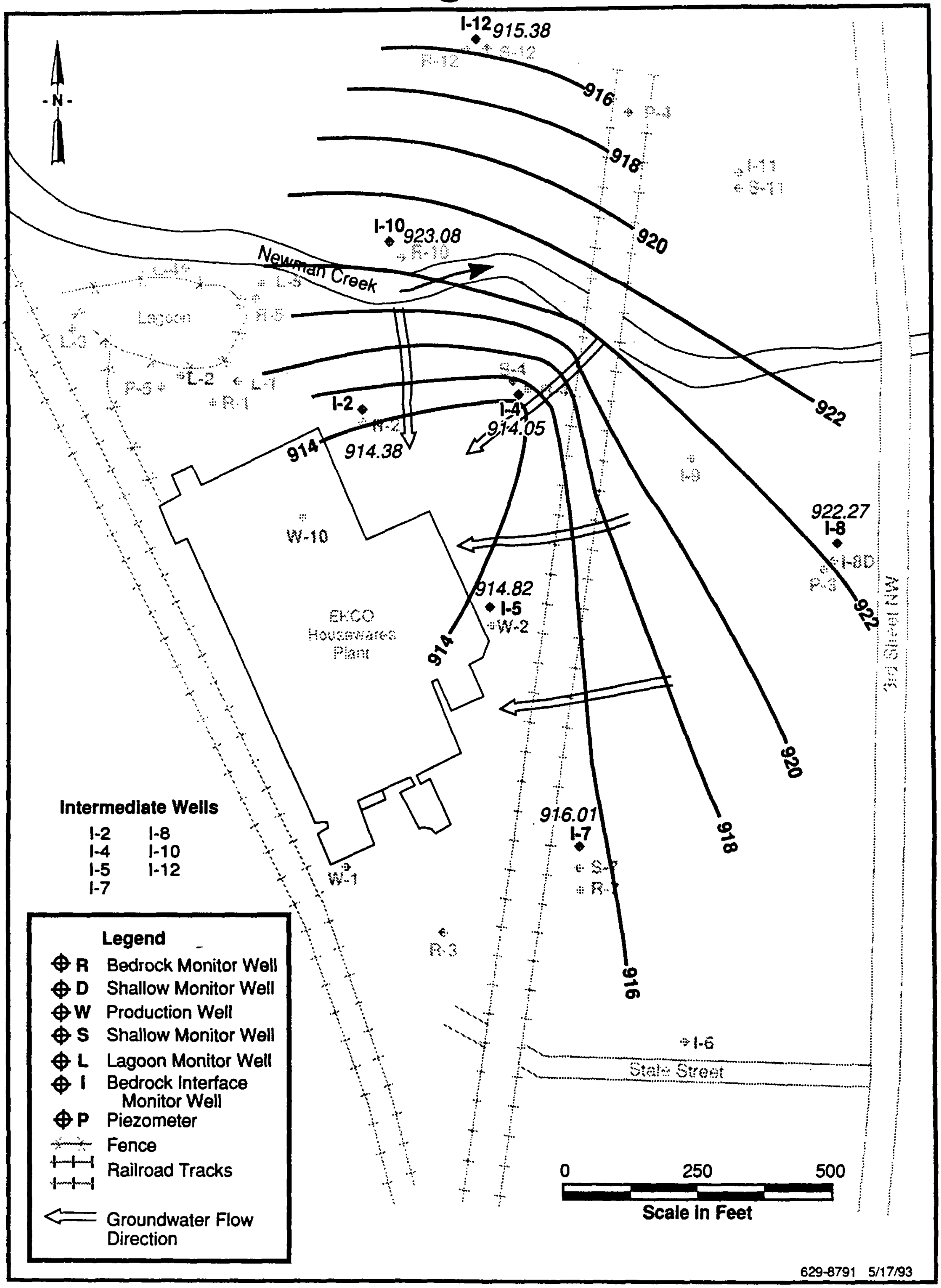

FIGURE 4-27 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE INTERMEDIATE SAND AND GRAVEL WATER BEARING ZONE, WATER LEVELS MEASURED 22 OCTOBER 1991

wells W-1 and W-10. However, these values represent the hydraulic condition which currently exist at the site.

The groundwater velocity may be slightly less east of the facility where the groundwater gradient is less, but this value is meant to be an order of magnitude estimate for conditions in the intermediate zone, particularly north and northeast of the EKCO plant.

4.6.3 Deep Hydrogeology

The deep zone is a permeable sand and gravel which varies from medium-grained sand with a lesser percentage of silt and gravel to cobbles (up to 6-inches) in a coarse-grained sand matrix. There are six wells that monitor the deep zone, i.e., I-6, I-80, I-9, I-11, I-13, and I-14. There are three OWS production wells completed in the deep zone approximately 2,000 ft northeast of the site OWS-1, OWS-2, and OWS-3. These three wells pump intermittently at cumulative flow rates up to 2,800 gpm. Figure 4-28 displays a contour map of deep groundwater flow developed from water levels measured on 22 October 1991. Groundwater contours on this figure indicate that the groundwater in the deep glacial sand and gravel aquifer is flowing north directly toward the OWS production wells OWS-1, -2, and -3. The deep sand and gravel unit is directly overlain by the intermediate till which is a low permeable clay and silt with a little gravel. This unit is truncated by the bedrock surface along the eastern portion of the site. The deep sand and gravel unit is underlain by a low permeable silt and clay which was encountered in wells I-8D and I-11.

There is a 9.74 ft drop in groundwater elevation from Well I-6 southeast of the site to Well I-13 northeast of the site adjacent to the OWS production wells. The average groundwater gradient for the deep zone was calculated from Well I-6 to Well I-13 by dividing the head difference by the distance between these two wells. The calculated average gradient was 0.0037 ft/ft.

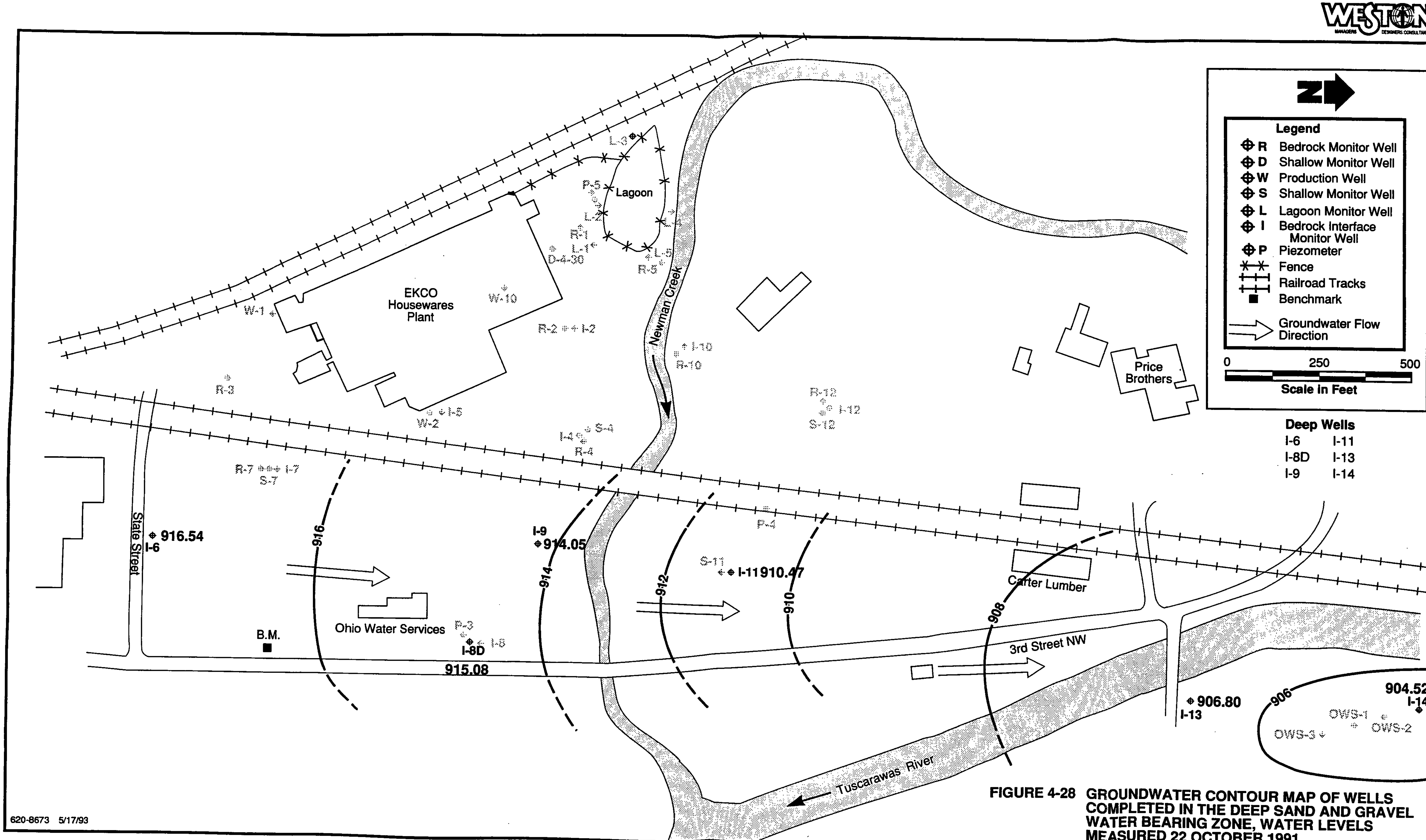

FIGURE 4-28 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE DEEP SAND AND GRAVEL WATER BEARING ZONE, WATER LEVELS MEASURED 22 OCTOBER 1991

The average groundwater seepage velocity for the deep sand and gravel aquifer was calculated to be 0.679 ft/day by using the hydrologic parameters and the seepage velocity form of Darcy's Law listed below:

$$v_s = Ki/\eta e$$

where:	v_s	=	seepage velocity,	=	0.679 ft/day
	K	=	hydraulic conductivity	=	29 ft/day
	i	=	groundwater gradient, dh/dl	=	0.00372 ft/ft
	ηe	=	effective porosity	=	15 %

The hydraulic conductivity was estimated from the results of the short term pumping test recovery data, and the effective porosity was estimated (Walton, 1985). The calculated groundwater gradient and seepage velocity are influenced by the pumping of the OWS production wells and values for non-pumping conditions would be different. However, these values represent the hydrologic conditions that currently exist at the area of the site.

4.6.4 Bedrock Hydrogeology

Bedrock encountered at the site consists of four interbedded shale, argillaceous sandstone, and sandstone units. All four of these units are shown in Figure 4-19. An interbedded shale and argillaceous sandstone is the shallowest bedrock unit encountered. These argillaceous sandstones coupled with the shale interbeds have a low permeability relative to the underlying sandstone unit. A well sorted, medium to coarse-grained sandstone underlies the upper interbedded shale and argillaceous sandstone. This unit is approximately 50 feet thick. The well sorted sandstone unit is underlain by interbedded shale and argillaceous sandstone followed by shale.

There are 11 wells that monitor the bedrock at the site. Seven of these wells (R-1 through R-4, W-1, W-2, and W-10) are open-hole wells that are open to all four bedrock units, and one well, R-5, is an open-hole well that is open to the upper shale and argillaceous sandstone unit. The other three bedrock wells (R-7, R-10, and R-12) are screened wells completed in the medium to coarse grained well sorted sandstone unit. The packer test results indicated that the sandstone unit is a productive permeable water bearing zone, and the overlying shale and argillaceous sandstone unit has low permeability and does not produce much water. The packer test results also showed that there is a downward gradient within the bedrock.

Figure 4-29 displays a contour map bedrock groundwater flow developed from water levels measured on 22 October 1991. Water levels for wells R-7, R-10 and R-12 were posted on the map but were not contoured because they are screened only in the sandstone and represent different hydrologic conditions than do the other bedrock wells. The groundwater contours on this figure show that a drawdown cone occurs around the pumping wells W-1 and W-10, and covers the entire EKCO site. This shows that the pumping of production wells W-1 and W-10 affect all the bedrock groundwater on the facility and cause it to flow toward the production wells and prevent it from flowing off EKCO property. This drawdown effect would have been less prior to 1988 when WESTON recommended doubling the pumpage of production wells W-1 and W-10, and would not have been present at all prior to the initiation of pumping of the EKCO production wells.

There is a drop in water elevation of 11.45 ft between wells R-1 and W-1, and 21.23 ft between wells R-2 and W-10. The average groundwater gradient from wells R-1 and R-2 to Well W-10 was 0.070 ft/ft. The average groundwater seepage velocity for the sandstone bedrock was calculated to be 38.7 ft/day by using the hydrologic parameters and the seepage velocity form of Darcy's Law listed below:

$$v_s = Ki/\eta e$$

where:	v_s	=	seepage velocity,	=	38.73 ft/day
	K	=	hydraulic conductivity	=	83 ft/day
	i	=	groundwater gradient, dh/dl	=	0.070 ft/ft
	ηe	=	effective porosity	=	15 %

The hydraulic conductivity was estimated from the results of the recovery/drawdown pumping test conducted in 1988, and the effective porosity was estimated from Walton (1985). The calculated groundwater gradient and seepage velocity are influenced by the

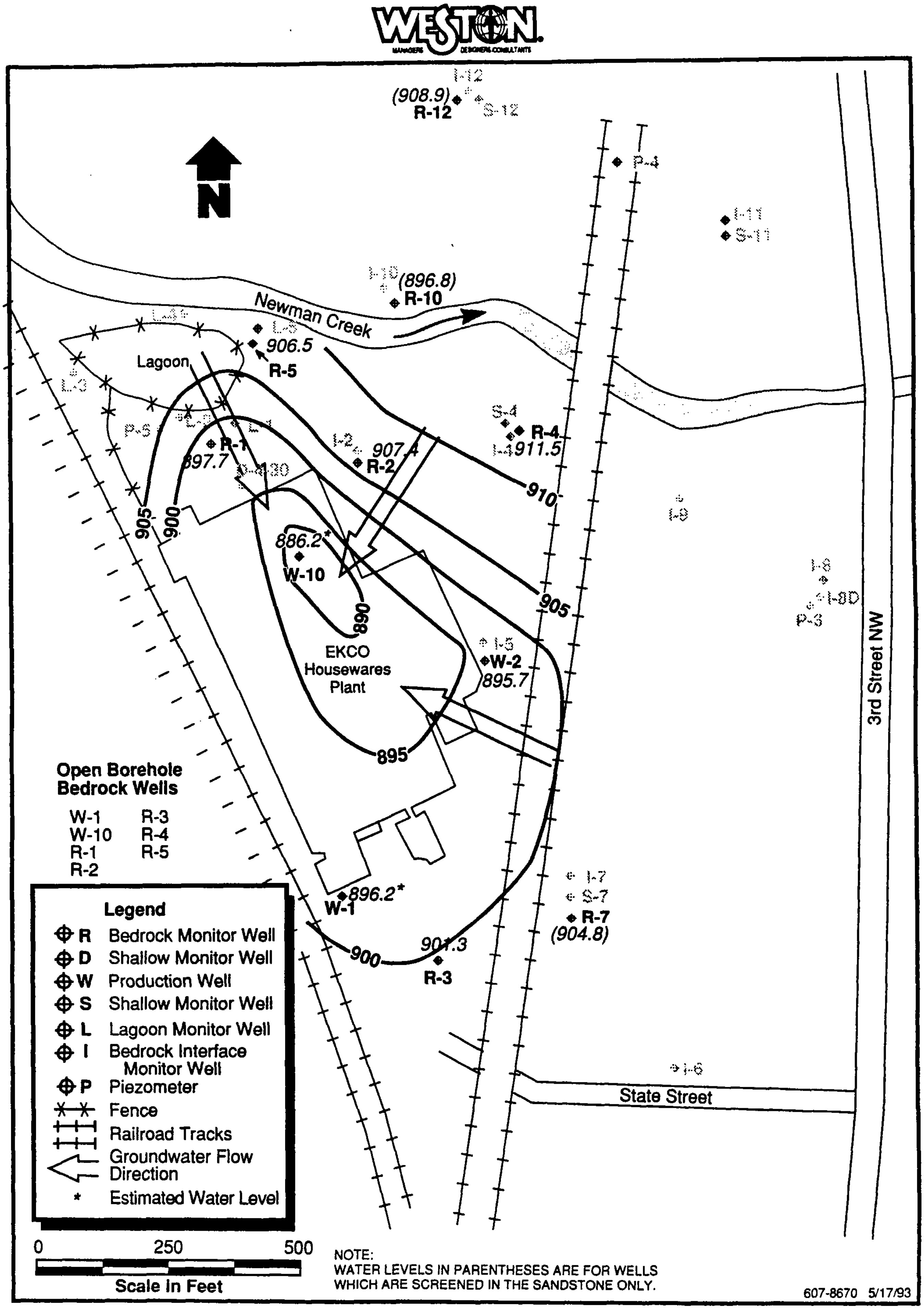

FIGURE 4-29 GROUNDWATER CONTOUR MAP OF OPEN BOREHOLE WELLS COMPLETED IN THE BEDROCK, WATER LEVELS MEASURED 22 OCTOBER 1991

pumping of the two EKCO production wells, W-1 and W-10, and values for non-pumping conditions would be different. However, these values represent the hydrologic conditions that currently exist at the site.

4.7 GROUNDWATER SAMPLING RESULTS

Monitor wells at the EKCO site were sampled once during the Groundwater Quality Assessment Program in September 1988, and they were sampled twice during the RFI in September of 1991 and March 1992. In addition, the five wells L-1 through L-5 have been sampled quarterly in February, May, August, and November since May 1989. During the RFI, all of the wells were sampled for VOC analysis, and all of the new wells were also sampled for metals analysis. All of the previously existing wells had been sampled for VOC and metals analyses in 1988, and all of the metals concentrations were below the applicable Maximum Contaminant Levels under the Safe Drinking Water Act. The L-wells are sampled quarterly for VOC and metals analyses. During the RFI groundwater sampling, 28 wells were sampled in September 1991, and 24 wells were sampled in March 1992. Wells R-1 through R-4 were not sampled in 1992 as part of the RFI because they had been sampled 1 month earlier in February 1992 as part of the quarterly groundwater sampling program.

The vertical stratigraphy of the site is divided into four distinct permeable hydrostratigraphic units: shallow silty sand, gravel and fill material, intermediate sand and gravel, deep sand and gravel, and sandstone bedrock. The sand and gravel units are separated by low permeability clay and/or silt layers. The groundwater sampling results for VOC and metals for these four hydrostratigraphic units are discussed below. In general, in order to remain consistent VOC concentration maps and discussions of VOC concentrations in the text were based on the 1991 sampling results.

4.7.1 General VOC Results

Most of the volatile organic compounds detected in groundwater samples were members of either the chlorinated ethene family or the chlorinated ethane family. Members of both of these groups break down in the environment, through inorganic dechlorination and other mechanisms, to create successively lighter daughter compounds. The breakdown chains for the two VOC groups of primary concern are as follows:

Chlorinated Ethenes:

Tetrachloroethene ⇒ Trichloroethene ⇒ 1,1-Dichloroethene / 1,2-Dichloroethene / (trans)1,2-Dichloroethene ⇒ Vinyl Chloride

Chlorinated Ethanes:

Tetrachloroethane ⇒ 1,1,1-Trichloroethane / 1,1,2-Trichloroethane ⇒ 1,2-Dichloroethane / 1,1-Dichloroethane ⇒ Chloroethane

In the chlorinated ethene group trichloroethene (TCE), two isomers of dichloroethene (1,1-DCE and 1,2-DCE undifferentiated) and vinyl chloride (VC) were detected in the groundwater on site. In the chlorinated ethane group only 1,1,1-TCA and 1,1-dichloroethane (1,1-DCA) were detected in the groundwater on site.

The molar ratios of the various "parent compounds" to their respective "daughter compounds" were examined in order to assess the relative ages of the plumes and to evaluate potential source areas and VOC migration in the groundwater. The molar ratios indicate the relative concentrations of compounds in a given groundwater sample. A high molar ratio, greater than 1, indicates a greater concentration of the parent compound than its daughter, which in turn indicates a relatively young portion of a plume. Areas in which the ratio is particularly high may also indicate a source area for the parent compound. A lower molar ratio, less than 1, indicates a greater concentration of the daughter compound than of the parent compound and, hence, an older part of the plume.

Although the molar ratio analysis indicates the relative age of a plume, it cannot determine its exact age. Rates of dechlorination are highly variable and are dependant upon a number of factors not explored in this project. The molar ratio analysis was conducted using the

September 1991 analytical results. Although some of the VOC concentrations had changed by the April 1992 investigation, the respective molar ratios remained largely unchanged.

4.7.1.1 Shallow Zone VOC Results

There are 12 monitor wells (P-3, S-4, S-7, S-11, S-12, D-4-30, I-2, and L-1 through L-5) completed in the shallow water-bearing unit. The shallow groundwater contour map, Figure 4-26 shows that the shallow groundwater in the area of the EKCO site currently flows toward the production wells W-1 and W-10.

The VOC results for the shallow unit are listed in Table 4-6 and displayed in Figures 4-30 through 4-38. The VOC detected in the shallow groundwater were predominately chlorinated ethenes and chlorinated ethanes. Figures 4-30 through 4-33 show the distribution of TCE, 1,2-DCE, 1,1-DCE and vinyl chloride in the shallow groundwater. These figures show that the highest concentrations of these compounds occurred at wells D-4-30 and I-2, indicating that the source area is near there. Figure 4-30 shows the TCE concentration at well D-4-30 is 75,000 ppb, which is one to five orders of magnitude higher than other shallow wells on-site. The figure also shows a relatively high TCE concentration of 590 ppb in the off-site well S-12. There are two shallow wells (L-5 and S-4) located midway between well D-4-30 and the off-site well S-12, which both have TCE concentrations of only 2 ppb or less.

The molar ratios of TCE/DCE_{TOTAL} and DCE_{TOTAL}/VC are shown on Figures 4-34 and 4-35. Figure 4-34 shows that there is a high TCE/DCE_{TOTAL} ratio (greater than one) in wells D-4-30, L-2 and I-2, indicating that those wells are in a relatively younger portion of the plume and closer to the source. Conversely, there is a low TCE/DCE_{TOTAL} ratio (less than one) at the north and east boundary of the site in wells L-4, L-5, L-1, S-4, S-7, indicating that those wells are in a relatively more mature portion of the plume and/or farther from the source. This figure also shows that well S-12 has a high TCE/DCE_{TOTAL} ratio of 8.06, indicating that it is part of a newer plume and/or closer to an off-site source area. Figure 4-35 shows that there is a high DCE_{TOTAL}/VC ratio north of the plant, at wells D-4-30, L-2,

Table 4–6

Shallow Groundwater Volatile Organic Compounds Sampling Results (ppb)

ANALYTE	P–3			S–4			S–7			S–11			S–12			D–4–30		
	12/88	9/91*	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
PCE	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	55	34	19
TCE	*	29	62	.16J	2	5	16	4	9	*	ND	ND	*	590	2300	220000	75000	25000
1,1–DCE	*	6	6	ND	ND	ND	1.9	ND	ND	*	ND	ND	*	ND	ND	1900	930	310
1,2–DCE	*	5	6	ND	ND	ND	ND	ND	ND	*	ND	ND	*	56	36	270	290	130
VC	*	ND	ND	3.5	ND	ND	ND	ND	ND	*	ND	ND	*	ND	5	8J	ND	ND
1,1,1–TCA	*	51	92	.21BJ	ND	ND	150	6	7	*	ND	ND	*	2	5	52000	17000	9700
1,1–DCA	*	51	84	ND	ND	ND	37	ND	3	*	ND	ND	*	ND	ND	1800	1600	110
TOLUENE	*	ND	ND	.80	ND	ND	13	ND	ND	*	ND	ND	*	ND	ND	130	11	ND
MeCL	*	ND	ND	ND	ND	7	ND	ND	4	*	ND	8	*	ND	9	ND	ND	4
ACETONE	*	ND	ND	17	ND	ND	17	ND	ND	*	ND	ND	*	ND	ND	ND	9JB	ND
1,2–DCA	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	73	34	ND
1,1,2–TCA	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	140	.66	ND
BENZENE	*	ND	ND	ND	ND	ND	.37	ND	ND	*	ND	ND	*	ND	ND	ND	ND	ND
CHLOROFORM	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	10	5	ND
CARBON DISULFIDE	*	ND	ND	2.8	ND	ND	ND	1	ND	*	ND	ND	*	ND	ND	ND	ND	ND
XYLENE	*	ND	ND	.42	ND	ND	1.4	ND	ND	*	ND	ND	*	ND	ND	5	ND	ND
ETHYLBENZENE	*	ND	ND	.33	ND	ND	.29	ND	ND	*	ND	ND	*	ND	ND	3J	ND	ND
2–BUTANONE	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	ND	ND	ND
4–METHYL 2–PENTANONE	*	ND	ND	ND	ND	ND	ND	ND	ND	* *	ND	ND	*	ND	ND	7J	ND	ND
1,3,5 TRI–METHYLBENZENE	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	ND	ND	ND
TRICHORO–FLOUROMETHANE	*	ND	ND	ND	ND	ND	ND	ND	ND	* *	ND	2	*	ND	2	ND	ND	ND
CHLOROETHANE	*	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND	ND	ND	ND

*Note: Comparison of the sample time in the field log book and on the laboratory sample bottles indicates that the sample bottles for wells P–3 and I–8D were accidently switched in the field in September 1991. Both the wells are being sampled again in August 1992 to confirm the results.

Table 4–6

Shallow Groundwater Volatile Organic Compounds Sampling Results (ppb)

ANALYTE	L-I			L-2			L-3			L-4			L-5			I-2		
	12/88	9/91	2/92	12/88	9/91	2/92	12/88	9/91	2/92	12/88	9/91	2/92	12/88	9/91	2/92	12/88	9/91	3/92
PCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	6210	51	360	130	85	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	510	460	490
1,1–DCE	3J	2	2	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	22	55	70
1,2–DCE	61	34	90	ND	1	3	ND	ND	ND	ND	70	20	92	69	18	480	130	160
VC	48	34	21	ND	ND	ND	ND	ND	ND	ND	4	ND	110	150	37	22	42	29
1,1,1–TCA	49	10	2	26	8	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	57	25	27
1,1–DCA	67	33	59	ND	1	2	ND	ND	ND	ND	22	21	ND	18	10	60	950	960
TOLUENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	ND	ND	ND	ND	ND	ND
MeCL	ND	ND	1	ND	ND	2	ND	ND	2	ND	ND	ND	ND	.9JB	ND	ND	ND	3
ACETONE	ND	ND	ND	ND	ND	6	ND	.8JB	ND	ND	ND	ND	ND	ND	ND	ND	8JB	ND
1,2–DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4J	ND	ND	ND	ND	ND
1,1,2–TCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
XYLENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2–BUTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4–METHYL 2–PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5 TRI–METHYLBENZENE	ND	ND	ND	ND	ND	ND ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TRICHORO–FLOUROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5

Notes: ND = Not Detected
B = Analyte Found in the Blank
J = Analyte Detected at a Concentration Below the Detection Limit

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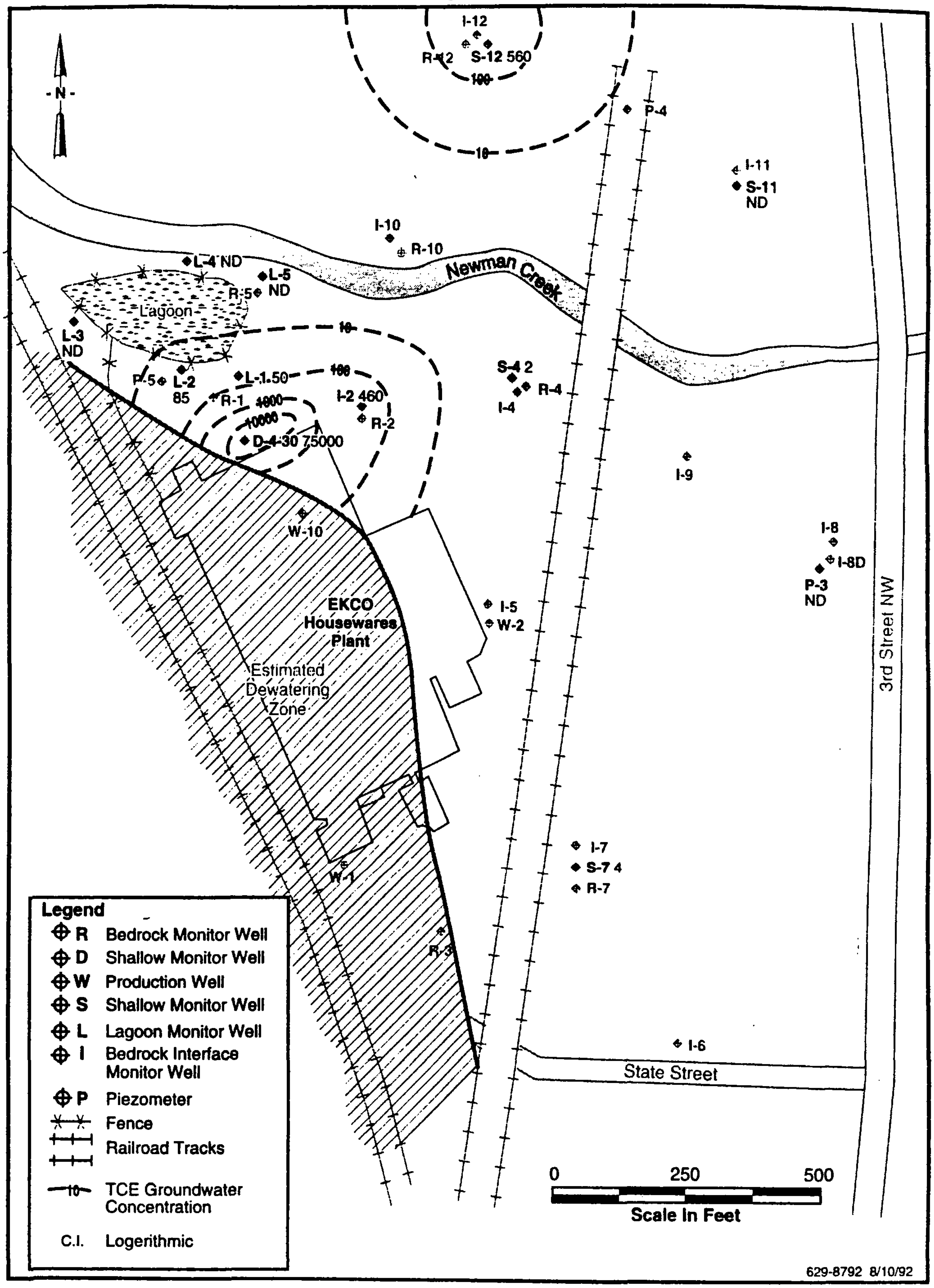

FIGURE 4-30 CONCENTRATION OF TRICHLOROETHENE (TCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

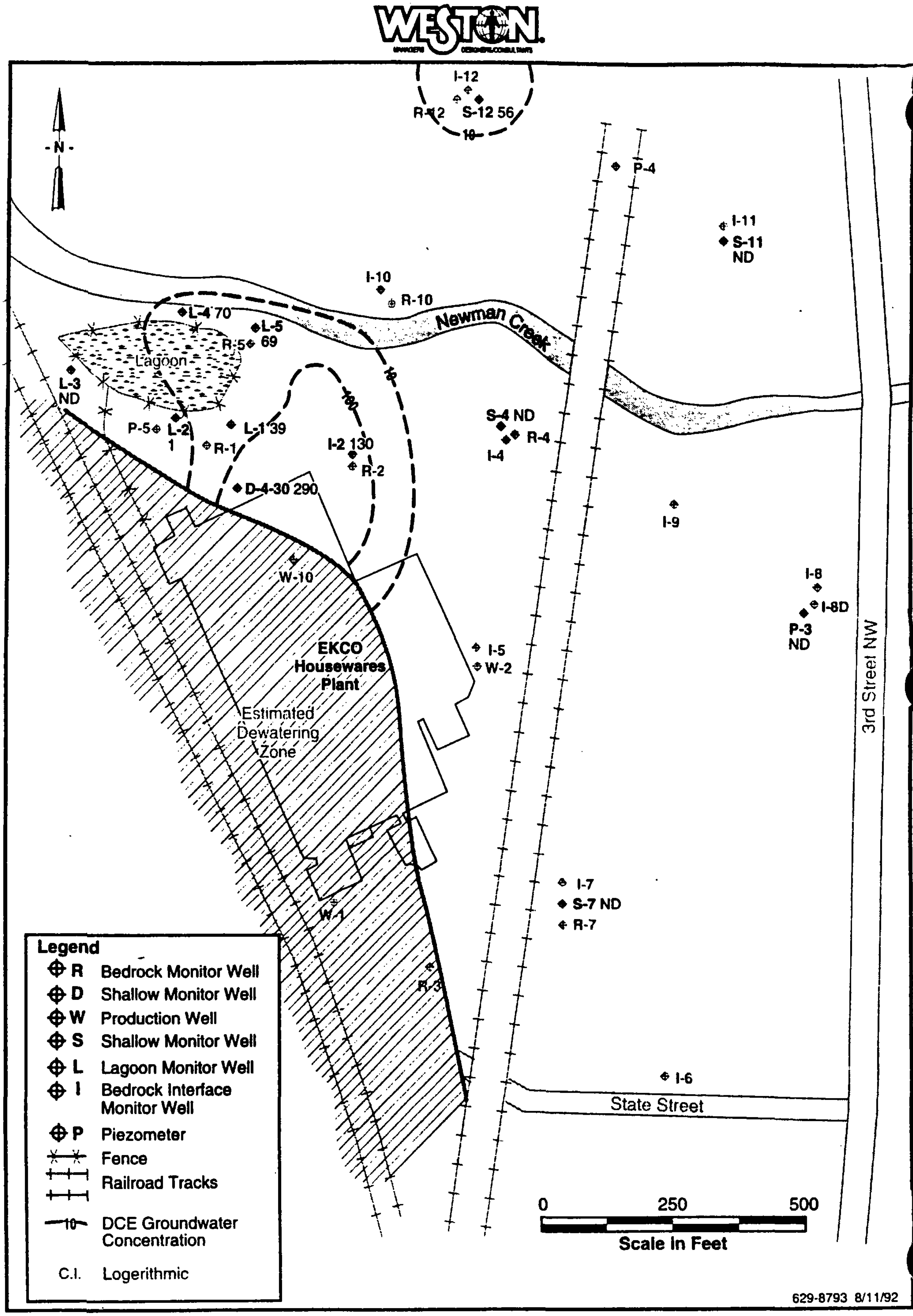

FIGURE 4-31 CONCENTRATION OF 1, 2 - DICHLOROETHENE (1,2 DCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

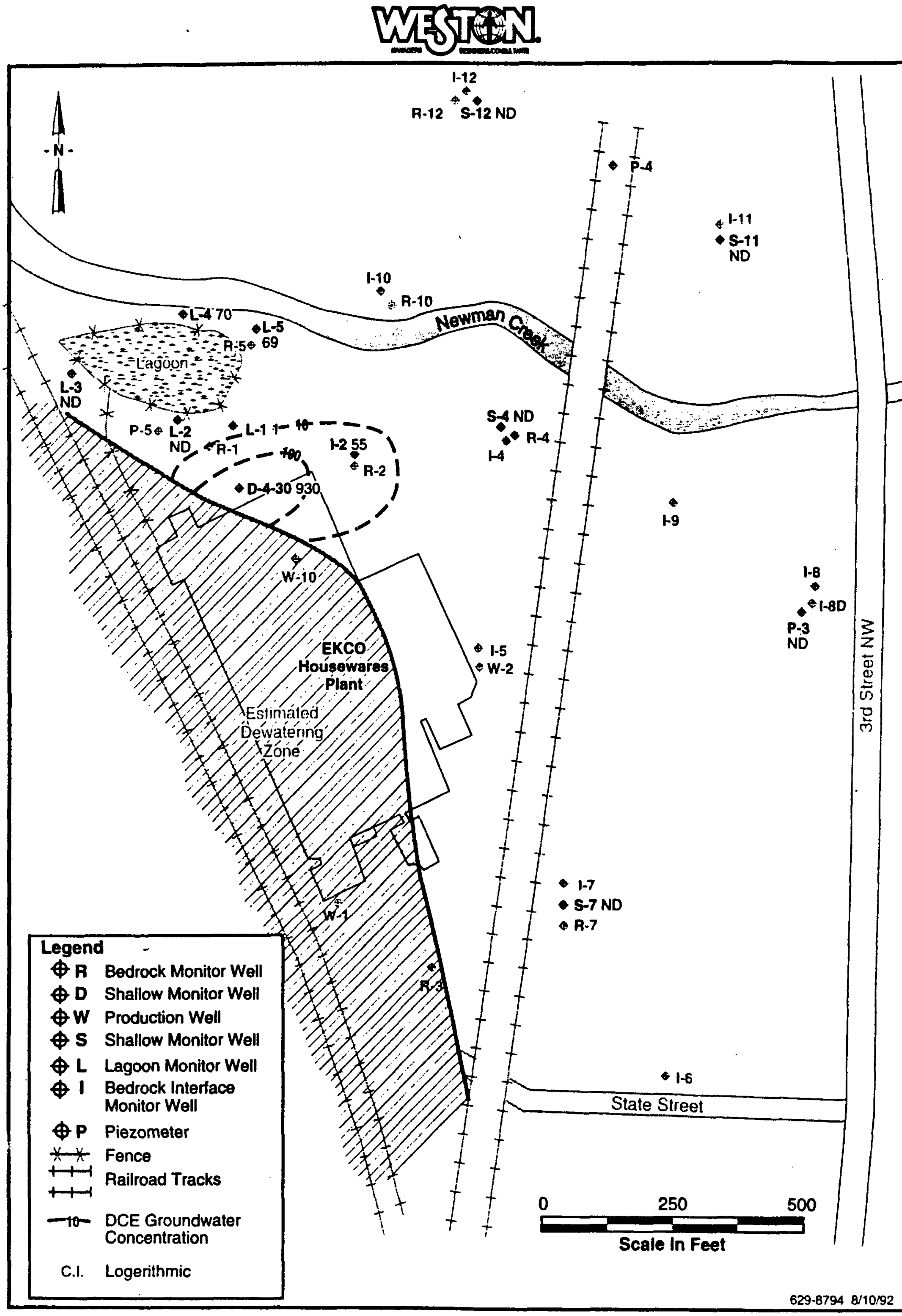

FIGURE 4-32. CONCENTRATION OF 1.1 - DICHLOROETHENE (I - DCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

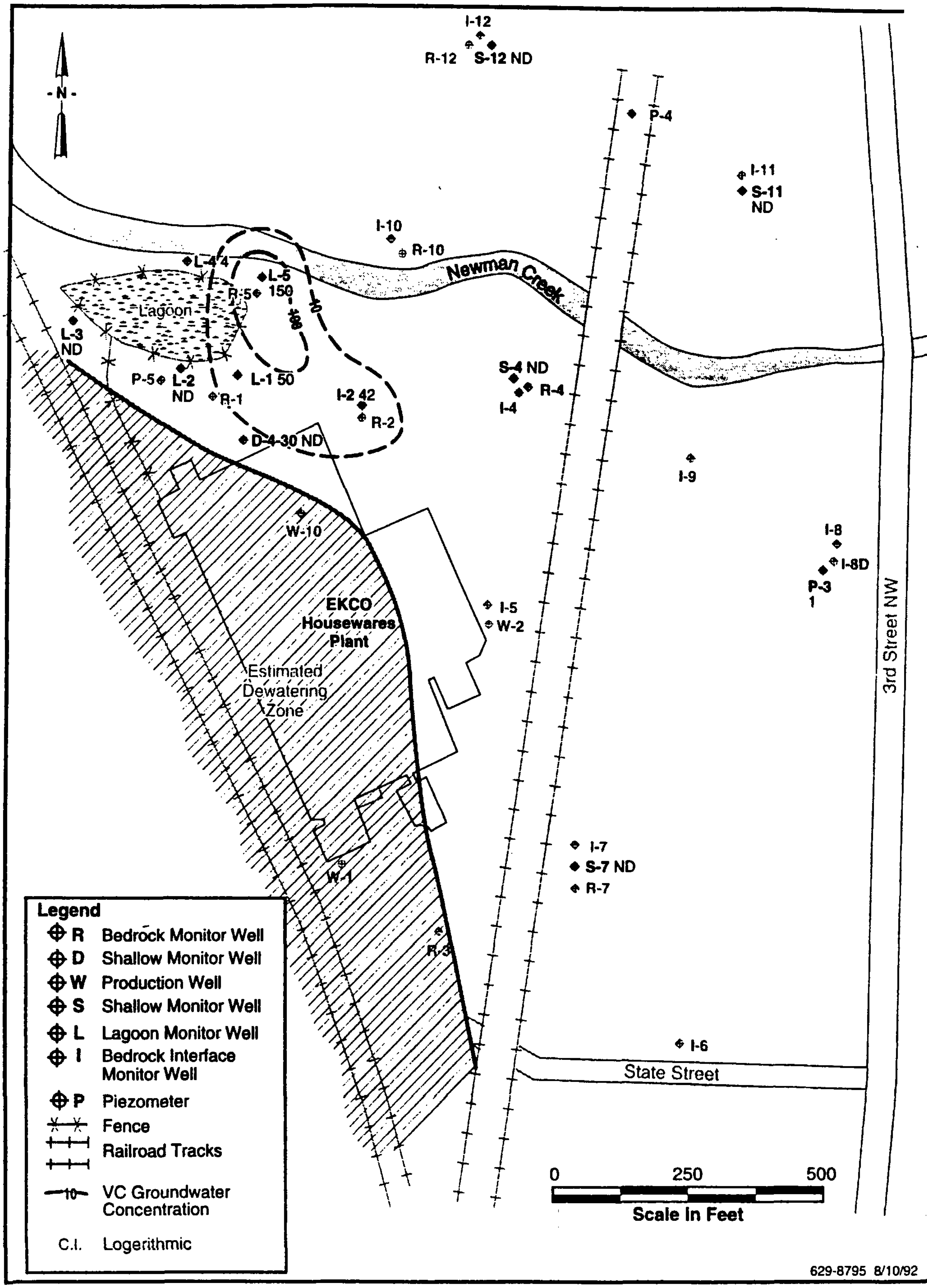

FIGURE 4-33 CONCENTRATION OF VINYL CHLORIDE GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

WESTON

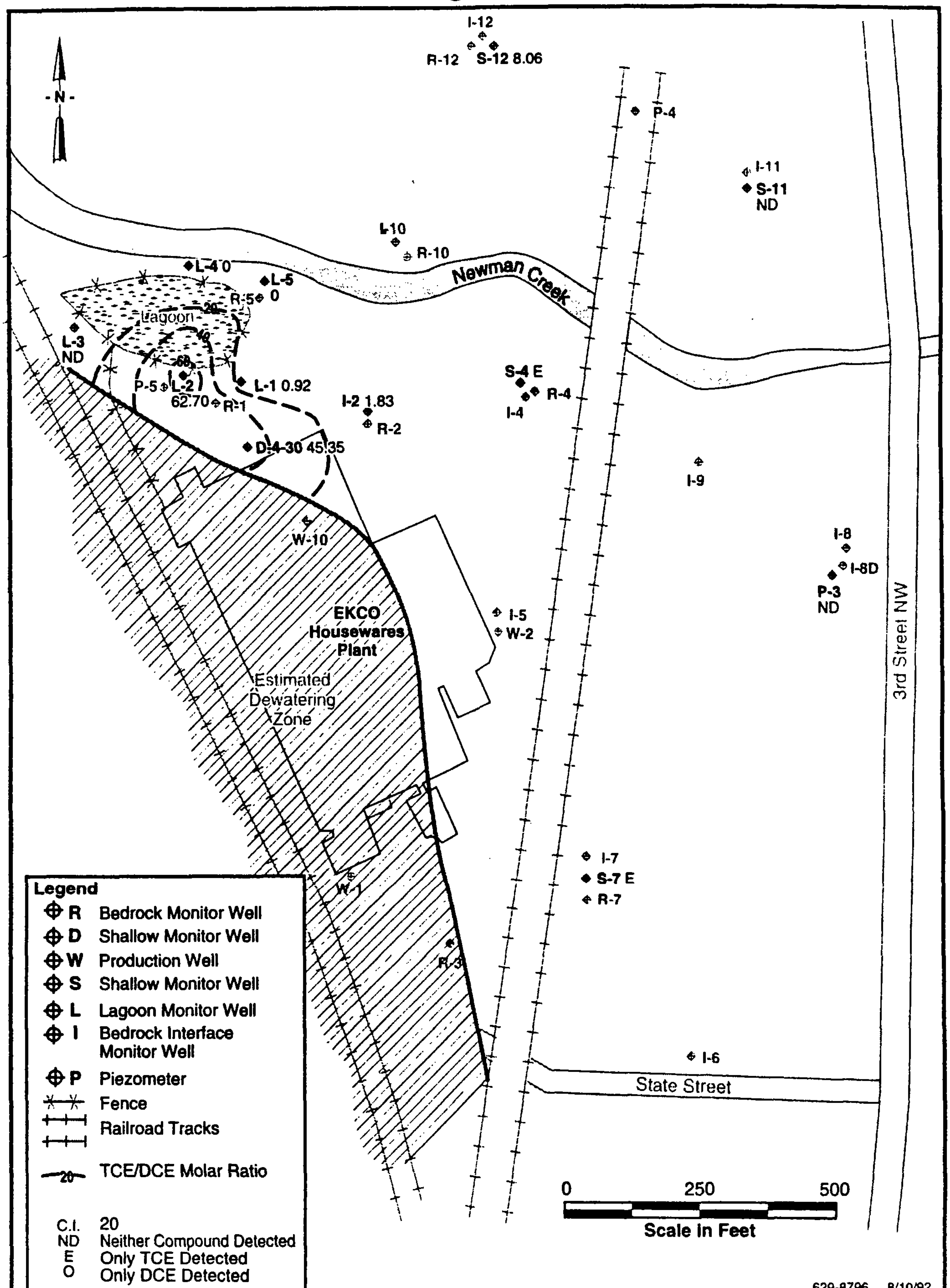

FIGURE 4-34 MOLAR RATIOS OF TRICHLOROETHENE TO TOTAL DICHLOROETHENE (TCE/DCE) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

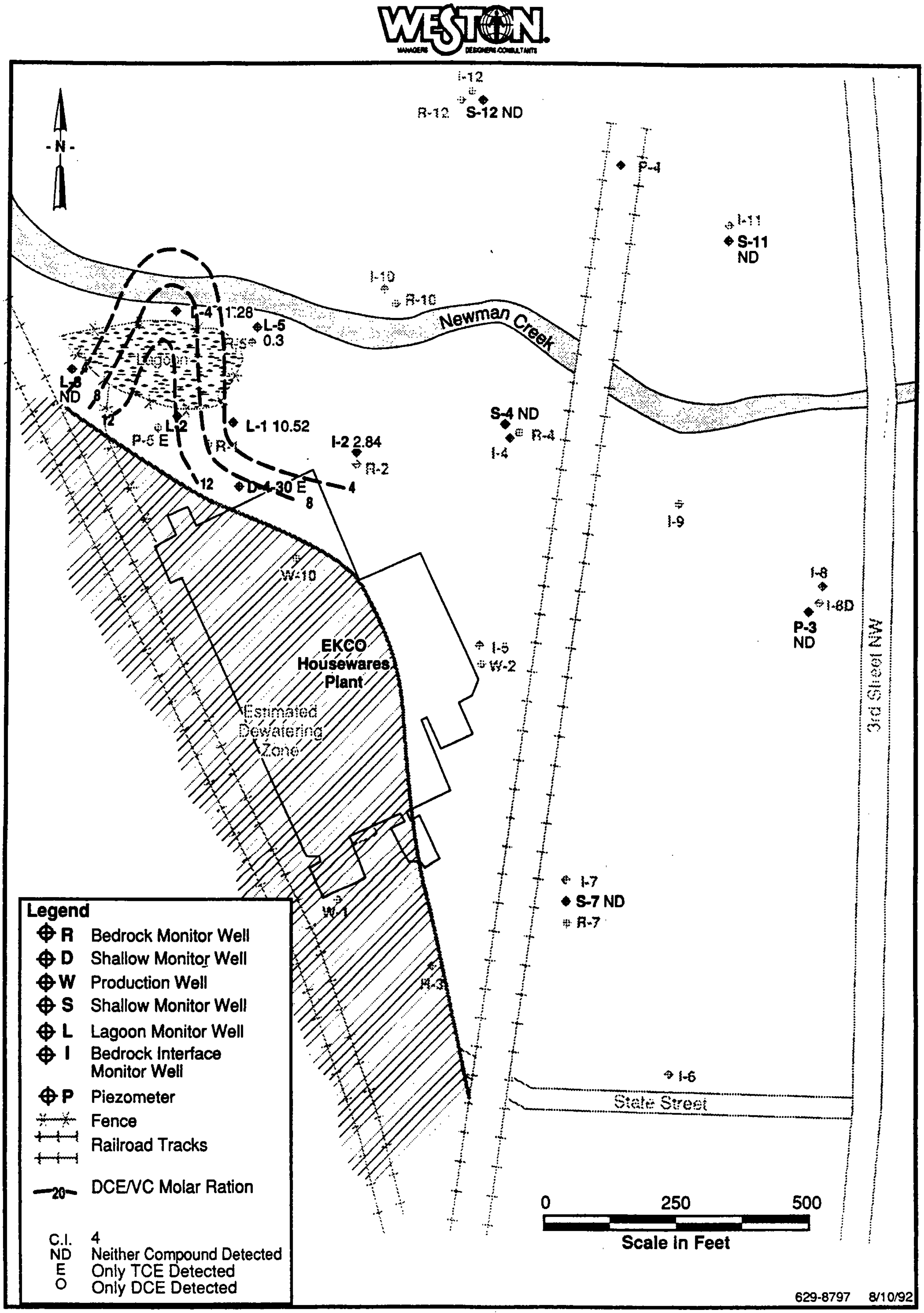

FIGURE 4-35 MOLAR RATIOS OF TOTAL DICHLOROETHENE TO VINYL CHLORIDE (DCE/VC) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

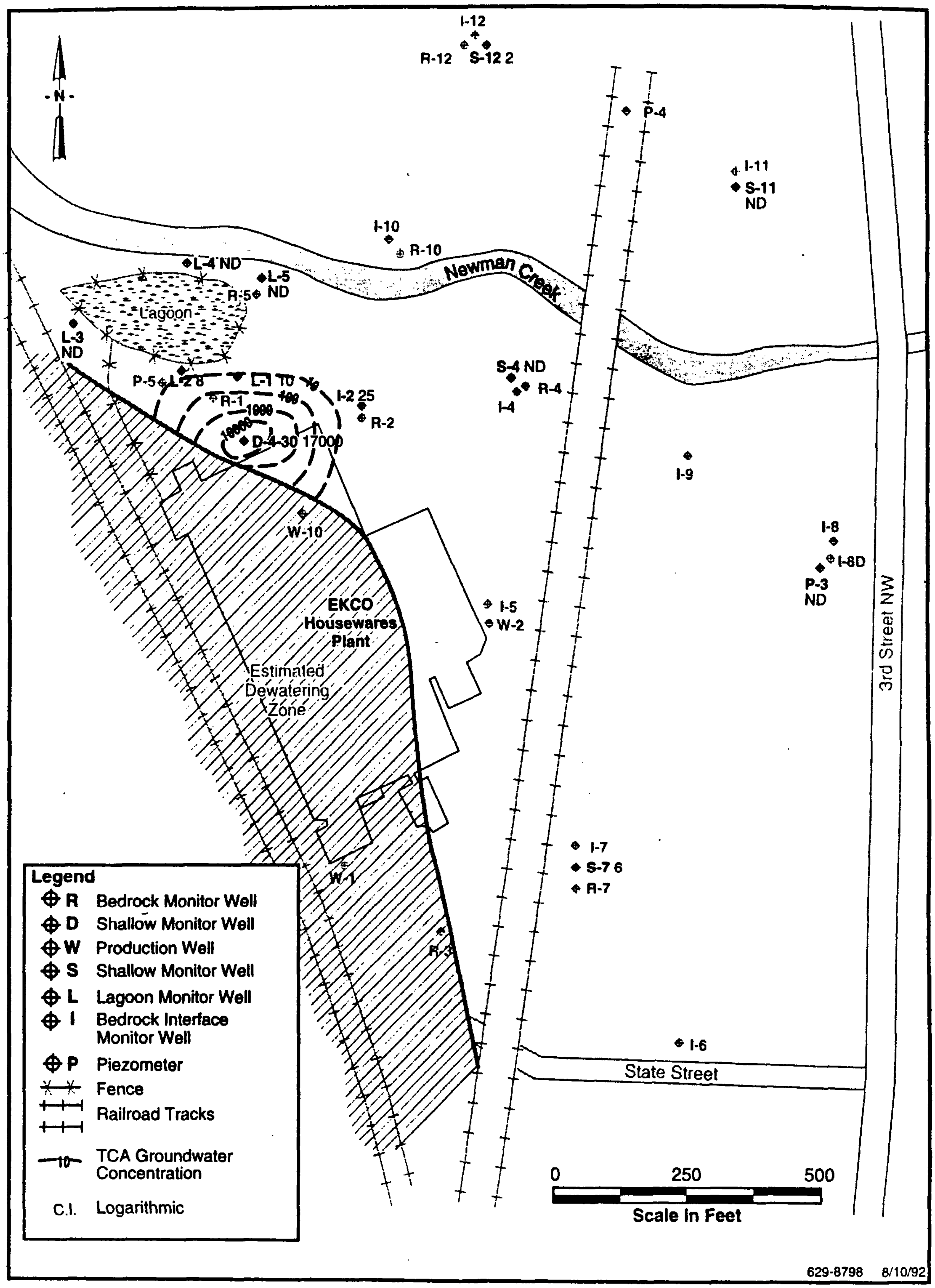

FIGURE 4-36 CONCENTRATIONS OF TOTAL TRICHLOROETHANE (1, 1, 1 - TCA) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

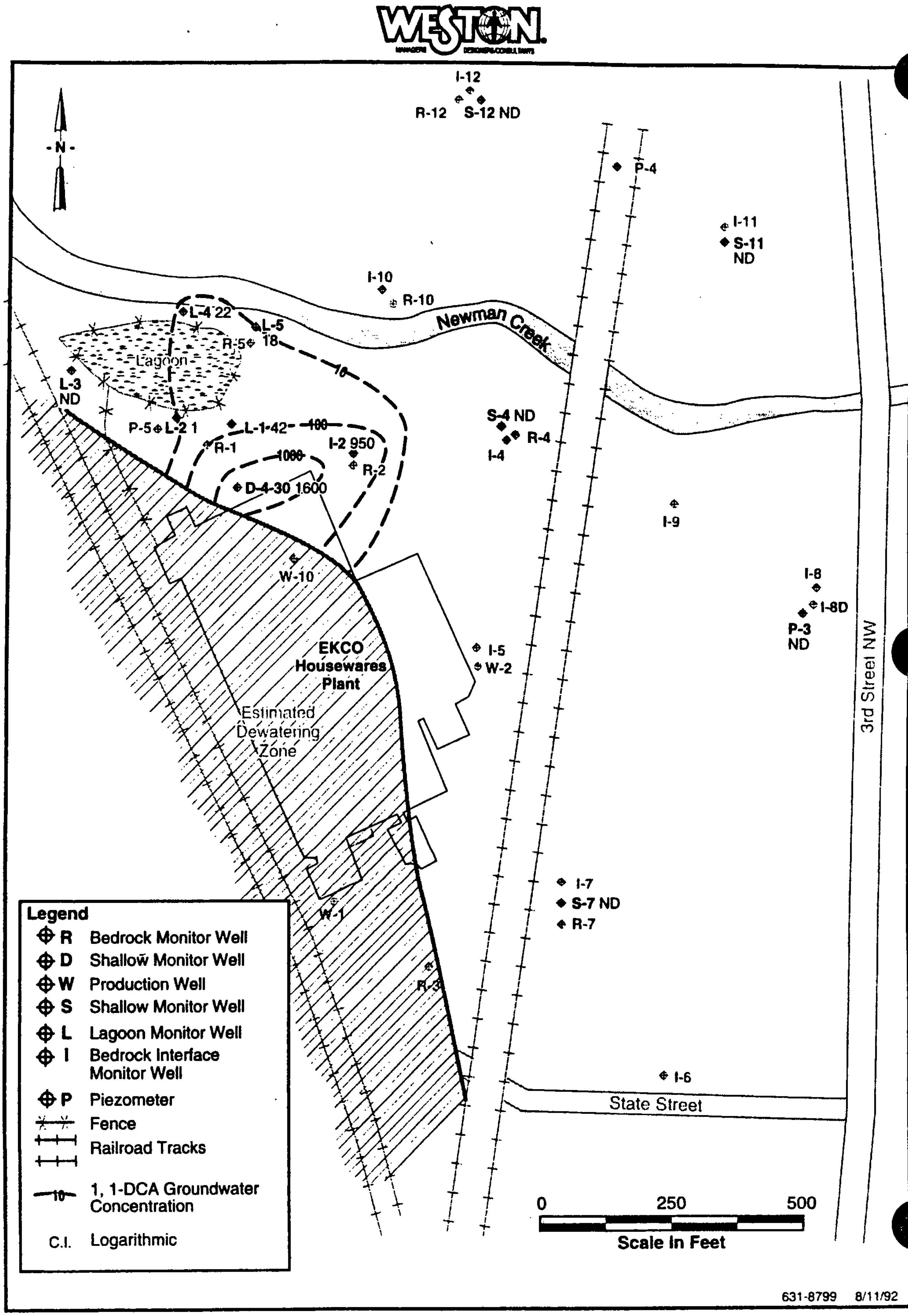

FIGURE 4-37 CONCENTRATIONS OF 1,1 - DICHLOROETHANE (1, 1 - DCA) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

WESTON

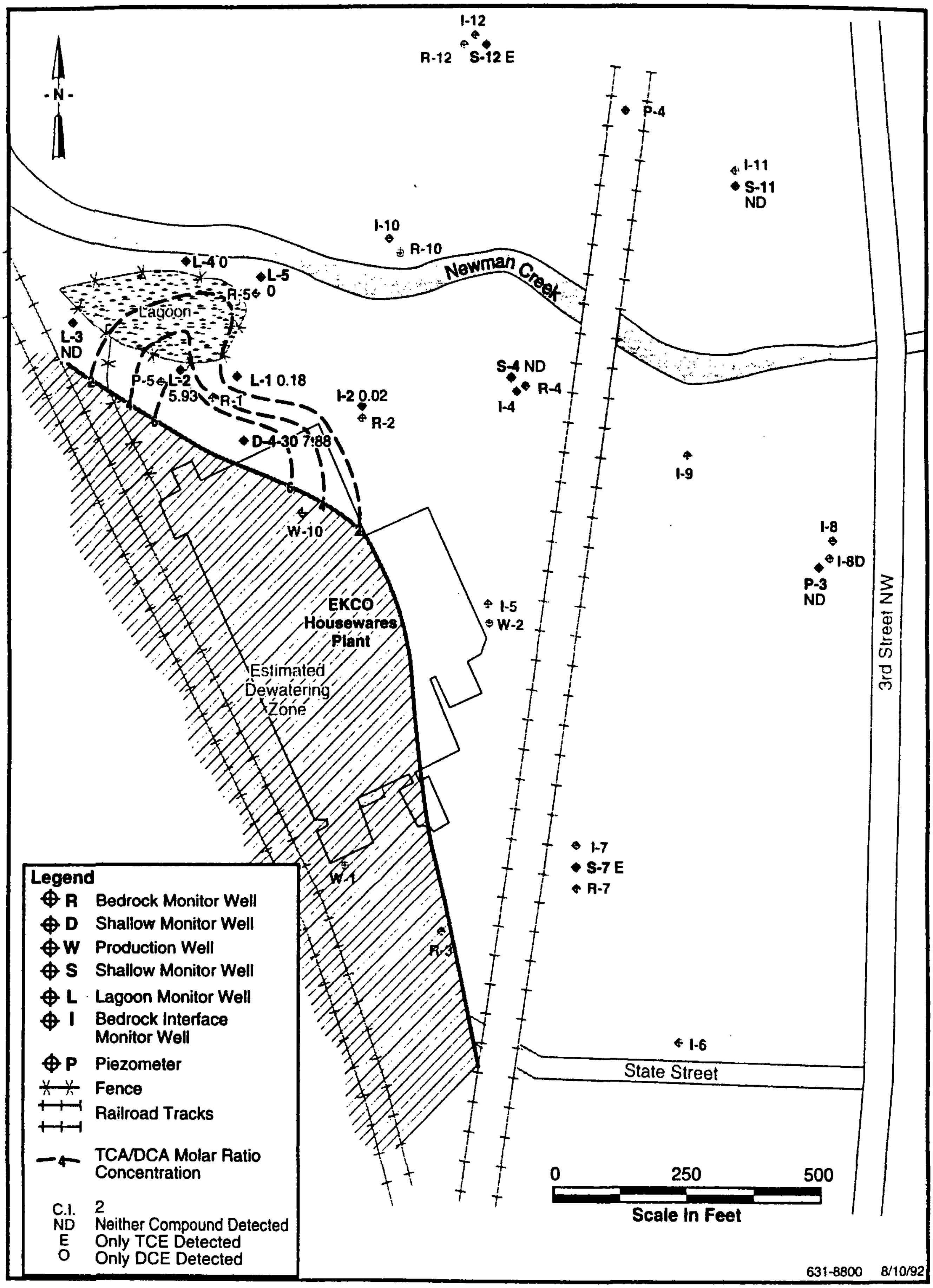

FIGURE 4-38 MOLAR RATIOS OF TRICHLOROETHANE TO TOTAL DICHLOROETHANE (TCA/DCA) FOR WELLS SCREENED IN THE SHALLOW WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

L-4, and I-2, indicating a relatively younger portion of the plume and closer to the source. There is a lower ratio in wells L-1 and L-5, indicating an older portion of the plume and farther from the source.

Figure 4-36 and 4-37 show the distribution of 1,1,1-TCA and 1,1-DCA in the shallow groundwater. Figure 4-36 shows that the parent compound concentration 1,1,1-TCA is four orders of magnitude higher in well D-4-30 than other wells, indicating that well D-4-30 is near the primary 1,1,1-TCA source. Figure 4-37 shows that the compound 1,1-DCA was found in six of the shallow wells with relatively higher concentrations in wells D-4-30 and I-2, indicating a probable source area near those two wells. Figure 4-38 shows that the 1,1,1-TCA/1,1-DCA ratio in the shallow groundwater is high in the two wells D-4-30 and L-2, indicating those wells are near the source and the others are more distant.

Examination of the chlorinated compound concentrations and their respective molar ratios indicates two main source areas in the shallow sand and gravel unit. The first is north of the EKCO plant, where both chemical concentrations and molar ratios are high, and where there are high chlorinated ethene and ethane concentrations in the soil indicating a surface source. The second area is north of Newman Creek, where moderate VOC concentrations and high molar ratios occurred. No high TCE or 1,1,1-TCA concentrations were detected in shallow wells near the lagoon, indicating that the lagoon is not a source of VOC.

4.7.1.2 Intermediate Zone VOC Results

There are six monitor wells (I-4, I-5, I-7, I-8, I-10, and I-12) that are completed exclusively in the intermediate water-bearing unit. In addition, Figure 4-22 shows that Well I-2 is completed in the shallow unit but since the clay layer may not be present there, the Well I-2 may also monitor conditions in the intermediate unit. The intermediate groundwater contour map, Figure 4-27 shows that the intermediate groundwater in the area of the EKCO site currently flows directly toward the two production wells, W-1 and W-10.

The VOC groundwater sampling results for the intermediate unit are listed in Table 4-7 and displayed on Figure 4-39. This figure shows that two of the seven intermediate wells, I-8 and I-10, had no VOCs detected. Well I-12 had concentrations of TCE, 4-methyl 2-pentanone, and 1,3,5-trimethylbenzene ranging from 0.4 ppb to 5 ppb. Three of the wells (I-4, -5 and -7) had only one compound detected; 1,1-DCA was detected in these wells at concentrations ranging from 48 to 440 ppb. Well I-2 had the six compounds (TCE, 1,1-DCE, 1,2-DCE, VC, 1,1,1-TCA, and 1,1-DCA) detected at relatively higher concentrations, ranging from 25 to 950 ppb. This well is close to the source areas at well W-10 and north of the plant.

4.7.1.3 Deep Zone VOC Results

There are seven monitor wells (I-6, -8D,-9, -11, -13, and -14) that are completed in the deep water-bearing unit. The three OWS production wells (OW-1, -2, and -3) are also completed in the deep water-bearing unit, between wells I-13 and -14. The deep groundwater contour map, Figure 4-28, shows that the groundwater in this unit flows directly north toward the OWS production wells. All seven of the deep wells were sampled in September 1991 and March 1992; well I-6 was also sampled in December 1988. All of the VOC groundwater sampling results for the deep unit are listed in Table 4-8. Figure 4-40 shows the VOC groundwater sampling results for September 1991. Table 4-8 shows that all of the six deep wells had VOCs detected during at least one of the sampling events. The compounds detected include TCE, 1,2-DCE, vinyl chloride, and toluene at concentrations ranging from less than 1 ppb to 9 ppb.

4.7.1.4 Bedrock Zone VOC Results

There are eight monitor wells (R-1 through -5, -7, -10, and -12) and three EKCO production wells (W-1, -2, and -10) that are completed in the bedrock. All of these wells were sampled during the RFI except the production well W-2 which was out of service. The bedrock groundwater contour map, Figure 4-29, clearly shows that the bedrock groundwater under the entire EKCO site currently flows directly toward the two in-service production wells,

Table 4-7

Intermediate Groundwater Volatile Organic Compounds Sampling Results (ppb)

Intermediate Groundwater ANALYTE	I-2			I-4			I-5			I-7			I-8			I-10			I-12		
	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
PCE	ND	ND	ND	ND	ND	ND	ND	ND	ND	.86	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND
TCE	510	460	490	ND	ND	2	240	ND	1	830	ND	14	.96	ND	1	*	ND	ND	*	.8	ND
1,1-DCE	22	55	70	ND	ND	ND	5	ND	ND	160	ND	2	ND	ND	ND	*	ND	ND	*	ND	ND
1,2-DCE	480	130	160	ND	ND	ND	ND	ND	ND	16	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND
VC	22	42	29	ND	ND	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND
1,1,1-TCA	57	25	27	ND	ND	ND	40	ND	ND	440	ND	11	.32JB	ND	ND	*	ND	ND	*	ND	ND
1,1-DCA	60	950	960	50	64	96	86	48	18	2200	440	140	3.8	ND	ND	*	ND	ND	*	ND	ND
TOLUENE	ND	ND	ND	25J	ND	ND	ND	ND	ND	1.9	ND	ND	15.4	ND	ND	*	ND	ND	*	ND	ND
MeCL	ND	ND	3	ND	ND	8	ND	ND	3	ND	ND	3	ND	ND	3	*	ND	9	*	ND	4
ACETONE	ND	8JB	ND	4.4	ND	ND	ND	ND	ND	8.1	ND	ND	21	ND	ND	*	ND	ND	*	ND	ND
1,2-DCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.7	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND
1,1,2-TCA	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.4	ND	ND	ND	ND	ND	*	ND	ND	*	ND	ND
BENZENE	ND	ND	ND	ND	ND	ND	4J	ND	ND	.13	ND	ND	.15	ND	ND	*	ND	ND	*	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	.18	ND	ND	*	ND	ND	*	ND	ND
CARBON DISULFIDE	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	1
XYLENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	*	ND	ND	*	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	.22	ND	ND	.32	ND	ND	*	ND	ND	*	ND	ND
2-BUTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.6	ND	ND	4.7	ND	ND	*	ND	ND	*	ND	ND
4-METHYL 2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	5	ND
1,3,5 TRI-METHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	.4	ND
TRICHORO-FLOUROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	*	ND	.8
CHLOROETHANE	ND	ND	5	ND	ND	ND	ND	ND	ND	6.4	ND	2	ND	ND	ND	*	ND	ND	*	ND	ND

Notes: ND = Not Detected
B = Analyte Found in the Blank
J = Analyte Detected at a Concentration Below the Detection Limit

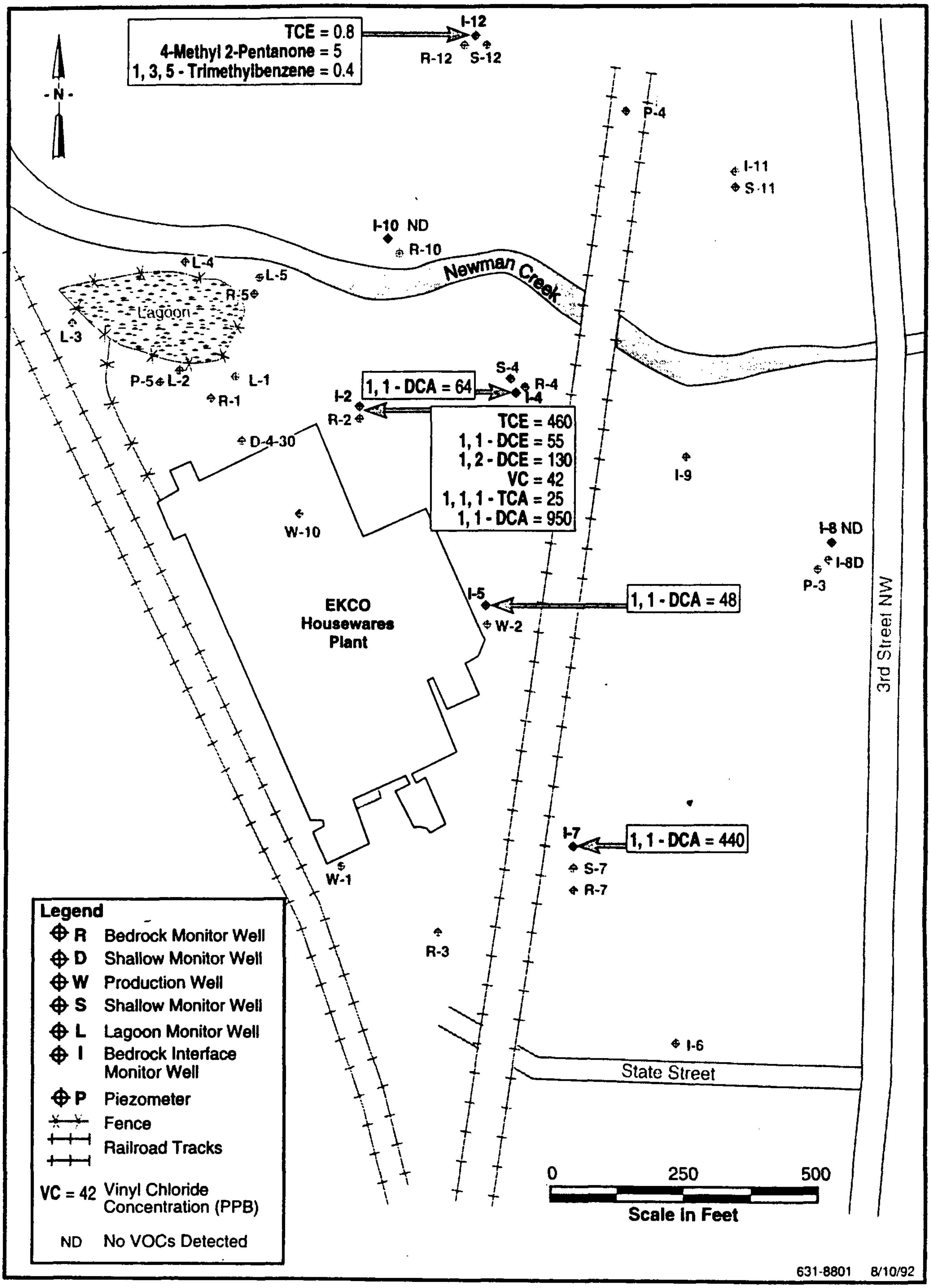

FIGURE 4-39 CONCENTRATION OF VOCs IN GROUNDWATER (PPB) FOR WELLS SCREENED IN THE INTERMEDIATE BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

Table 4–8

Deep Groundwater Volatile Organic Compounds Sampling Results (ppm)

Deep Groundwater ANALYTE	I–6			I–8D			I–9			I–11			I–13			I–14		
	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
PCE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
TCE	ND	ND	1	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	1	*	ND	ND
1,1–DCE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,2–DCE	ND	ND	ND	*	ND	ND	*	2	3	*	ND	ND	*	ND	ND	*	ND	ND
VC	ND	ND	ND	*	1	ND	*	5	7	*	4	9	*	4	3	*	ND	ND
1,1,1–TCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,1–DCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
TOLUENE	1.6	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	.9	ND	*	ND	ND
MeCL	ND	ND	4	*	ND	5	*	ND	5	*	ND	5	*	ND	4	*	ND	6
ACETONE	19	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,2–DCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,1,2–TCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
BENZENE	.27	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
CHLOROFORM	.18	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
CARBON DISULFIDE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	1	*	ND	ND
XYLENE	.87	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
ETHYLBENZENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
2–BUTANONE	4.2	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
4–METHYL 2–PENTANONE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,3,5 TRI– METHYLBENZENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
TRICHORO– FLOUROMETHANE	ND	ND	ND	*	ND	ND	*	ND	1	*	ND	1	*	ND	.7	*	ND	.8
CHLOROETHANE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND

* Note: Comparison of the sample time in the field log book and on the laboratory sample bottles indicates that the sample bottles for wells P–3 and I–8D were accidently switched in the field in September 1991. Both the wells are being sampled again in August 1992 to confirm the results.

Notes: ND = Not Detected
B = Analyte Found in the Blank
J = Analyte Detected at a Concentration below the Detection Limit

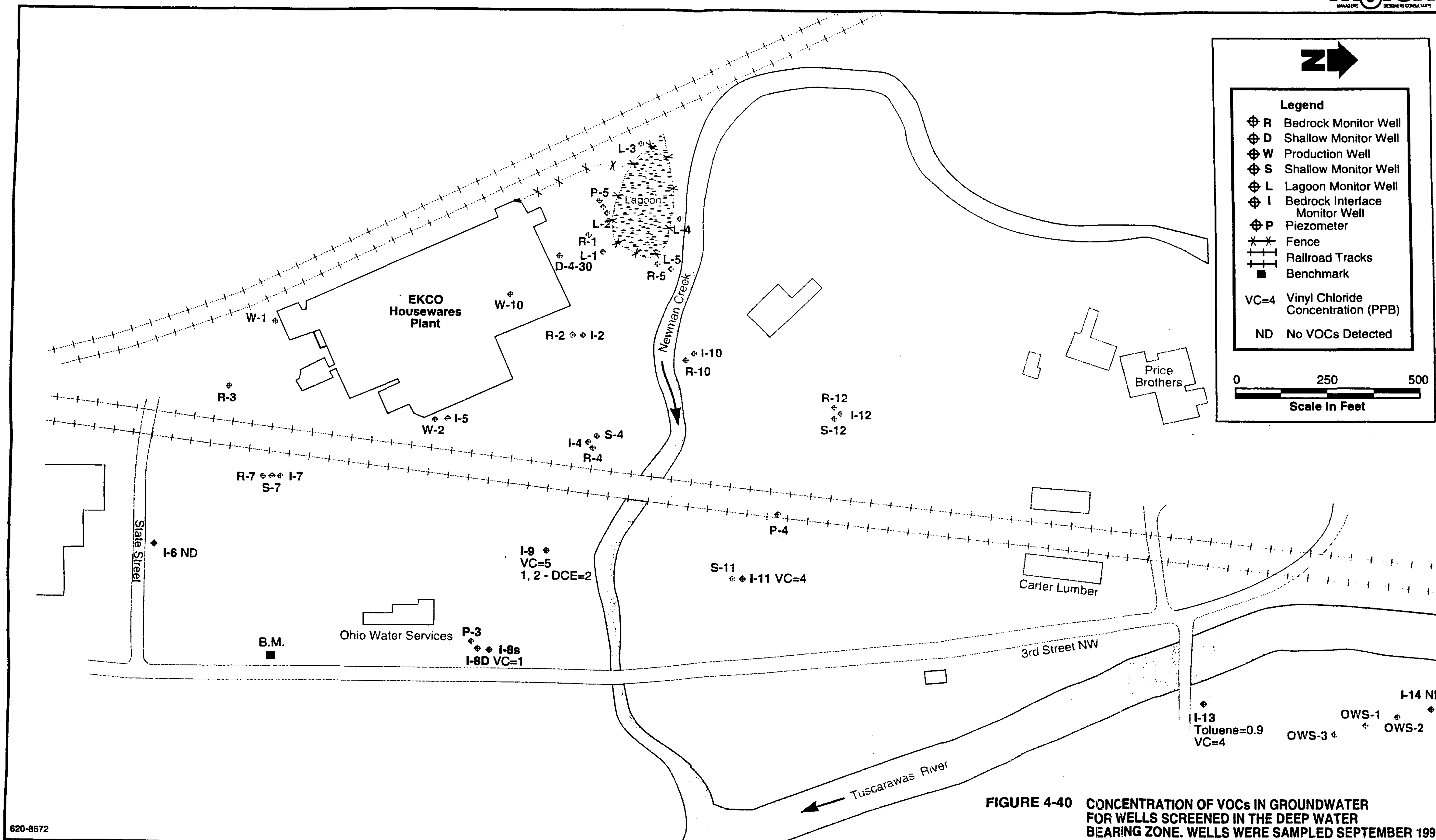

FIGURE 4-40 CONCENTRATION OF VOCs IN GROUNDWATER FOR WELLS SCREENED IN THE DEEP WATER BEARING ZONE. WELLS WERE SAMPLED SEPTEMBER 1991

W-1 and W-10. Prior to increasing the flow rates of these two production wells in 1988, the flow toward the wells would not have been as great.

The VOC groundwater sampling results for the bedrock unit are listed in Table 4-9 and displayed in Figures 4-41 through 4-49. The VOCs detected in the bedrock groundwater were predominately chlorinated ethenes and chlorinated ethanes. Figures 4-41 through 4-44 show the distribution of TCE, 1,2-DCE, 1,1-DCE, and VC in the bedrock groundwater. The figures show that the highest concentrations of these compounds occur at wells W-10, R-1 and R-2. These wells are adjacent to the source areas previously identified as the sump at production well W-10 and the tank area at the northern end of the plant.

The molar ratios of TCE/DCE_{TOTAL} and DCE_{TOTAL}/VC are shown on Figures 4-45 and 4-46. Figure 4-45 shows that there is a high TCE/DCE_{TOTAL} ratio (greater than one) in wells W-1, W-10, R-1, R-2, R-3, R-4 and R-7, indicating that those wells are in a relatively younger portion of the plume and closer to the source. Conversely, there is a low TCE/DCE_{TOTAL} ratio (less than one) in wells R-5, R-10 and R-12 indicating that those wells are in a relatively more mature portion of the plume and farther from the source. Figure 4-46 shows that there is a high DCE_{TOTAL}/VC ratio in all wells except R-4, indicating that a relatively small amount of the DCE has degraded all the way to vinyl chloride except for the area near well R-4.

Figure 4-47 and 4-48 show the distribution of 1,1,1-TCA and 1,1-DCA in the bedrock groundwater. Figure 4-47 shows that the concentration of the parent compound, 1,1,1-TCA is one to two orders of magnitude higher in well W-10 than in all the other bedrock wells. This indicates that well W-10 is the primary source area for 1,1,1-TCA and its breakdown products. Figure 4-48 shows that the breakdown product, 1,1-DCA was found in all bedrock wells, indicating that the 1,1,1-TCA has had sufficient time to breakdown to 1,1-DCA.

The molar ratios of 1,1,1-TCA to 1,1-DCA are shown on Figure 4-49. This figure shows that there is a high 1,1,1-TCA/1,1-DCA ratio (greater than one) in two of the bedrock wells W-10 and R-1, which also indicates that these wells are in a relatively younger portion of the

Table 4–9

Bedrock Groundwater Organic Compounds Sampling Results (ppm)

Bedrock Groundwater ANALYTE	W–1			W–10			R–1			R–2			R–3			R–4		
	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
PCE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
TCE	66	36	140	1100	470	790	800	390	NS	2600	760	NS	ND	8	NS	.19J	2	NS
1,1–DCE	ND	ND	8	49	22	21	29	ND	NS	ND	51	NS	27	ND	NS	ND	ND	NS
1,2–DCE	ND	ND	12	53	170	200	90	83	NS	320	180	NS	ND	ND	NS	ND	NDE	NS
VC	ND	ND	ND	ND	ND	3	35J	25	NS	220	130	NS	9J	ND	NS	ND	2	NS
1,1,1–TCA	ND	65	37	2700	1100	1600	400	54	NS	ND	16	NS	ND	49	NS	ND	ND	NS
1,1–DCA	64	75	70	140	77	100	70	17	NS	110	240	NS	110	51	NS	.72	2	NS
TOLUENE	ND	ND	ND	ND	ND	.6J	ND	ND	NS	ND	ND	NS	ND	ND	NS	.54	ND	NS
MeCL	ND	ND	3	ND	ND	3	ND	ND	NS	ND	ND	NS	5	ND	NS	ND	ND	NS
ACETONE	ND	ND	ND	ND	ND	ND	19.05	ND	NS	ND	ND	NS	ND	ND	NS	6	ND	NS
1,2–DCA	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
1,1,2–TCA	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	.09	ND	NS
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
XYLENE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	..21	ND	NS
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
2–BUTANONE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
4–METHYL 2–PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
1,3,5 TRI– METHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
TRICHORO– FLOUROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS

WESTON MANAGERS DESIGNERS/CONSULTANTS

Table 4–9

Bedrock Groundwater Organic Compounds Sampling Results (ppm)

(Continued)

Bedrock Groundwater ANALYTE	R–5			R–7			R–10			R–12		
	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
PCE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
TCE	40	20	6	*	35	69	*	39	170	*	4	17
1,1–DCE	.84	IFF8	9	*	4	7	*	8	27	*	ND	3
1,2–DCE	100	51	12	*	2	6	*	30	110	*	4	16
VC	ND	34	ND	*	ND	ND	*	7	35	*	9	ND
1,1,1–TCA	ND	ND	ND	*	4	6	*	2	4	*	ND	ND
1,1–DCA	4.9	5	1	*	21	38	*	58	260	*	5	22
TOLUENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
MeCL	ND	ND	2	*	ND	7	*	ND	8	*	ND	9
ACETONE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,2–DCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,1,2–TCA	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
BENZENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
CHLOROFORM	.55	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
CARBON DISULFIDE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
XYLENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
ETHYLBENZENE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
2–BUTANONE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
4–METHYL 2–PENTANONE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND
1,3,5 TRI–METHYLBENZENE	ND	ND	ND	*	ND	ND	.*	ND	ND	*	ND	ND
TRICHORO–FLOUROMETHANE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	2
CHLOROETHANE	ND	ND	ND	*	ND	ND	*	ND	ND	*	ND	ND

Notes: ND = Not Detected
B = Analyte Found in the Blank
J = Analyte Detected at a Concentration Below the Detection Limit

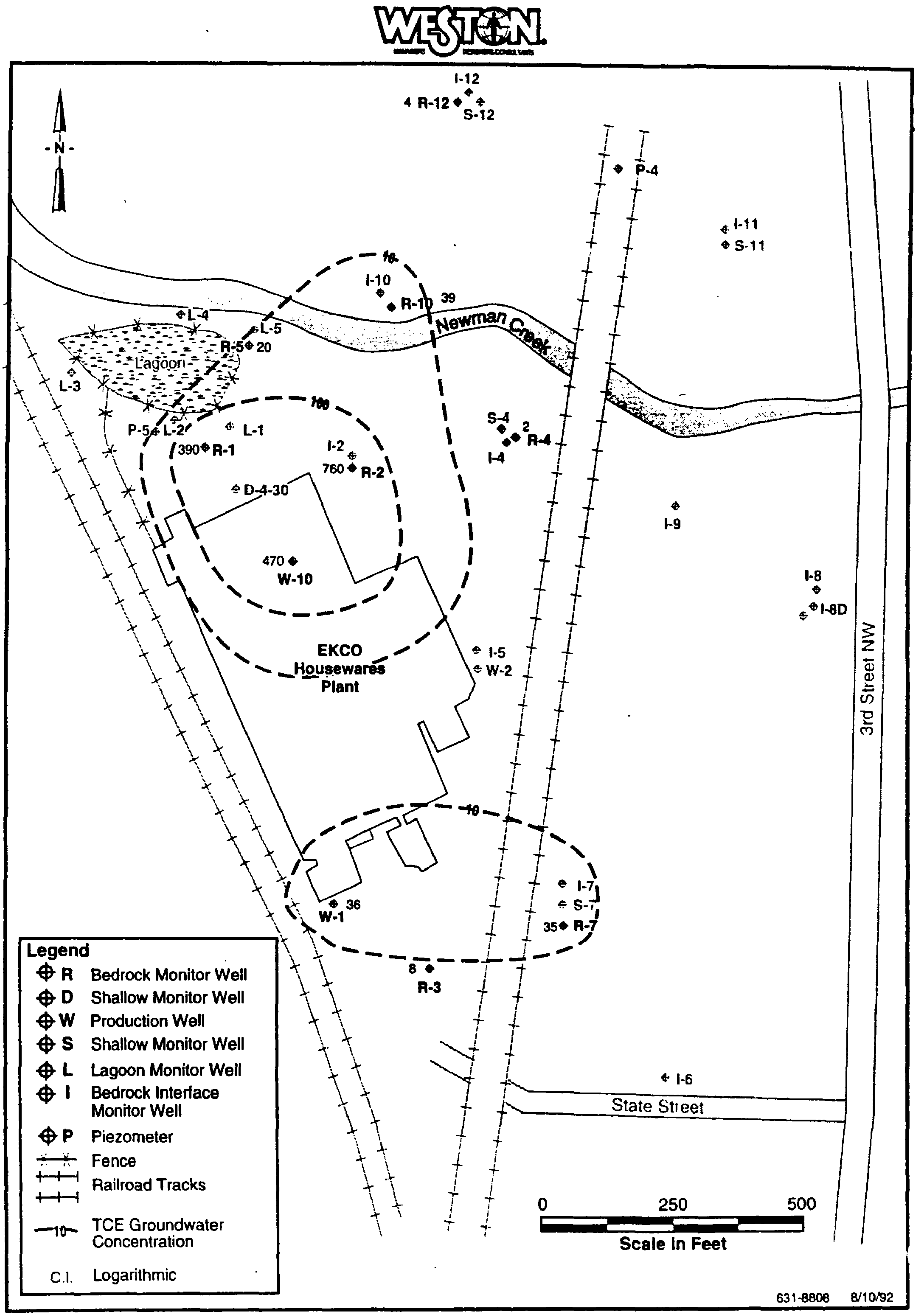

FIGURE 4-41 CONCENTRATION OF TRICHLOROETHENE (TCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

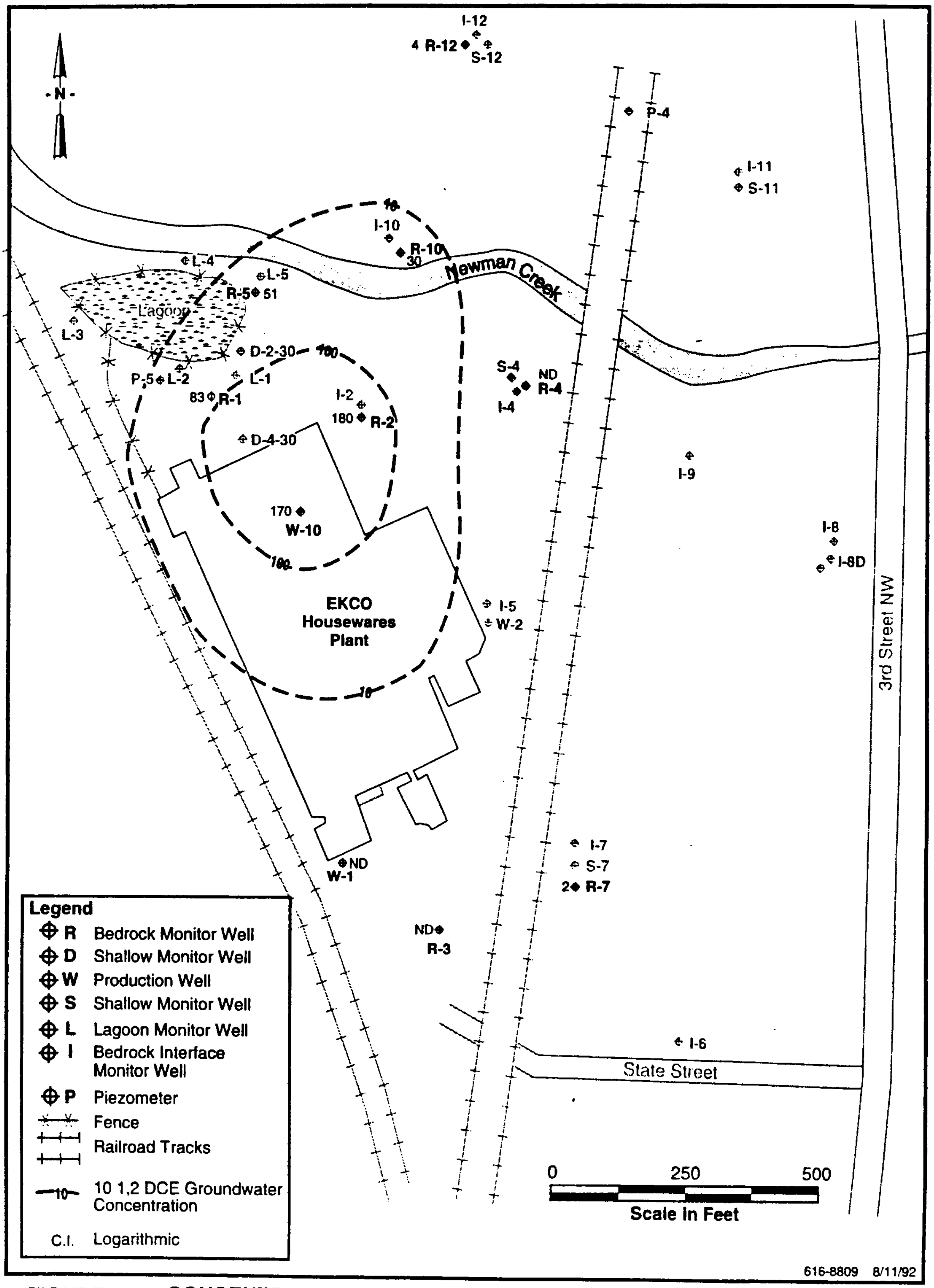

FIGURE 4-42 CONCENTRATION OF 1,2-DICHLOROETHENE (1,2 DCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

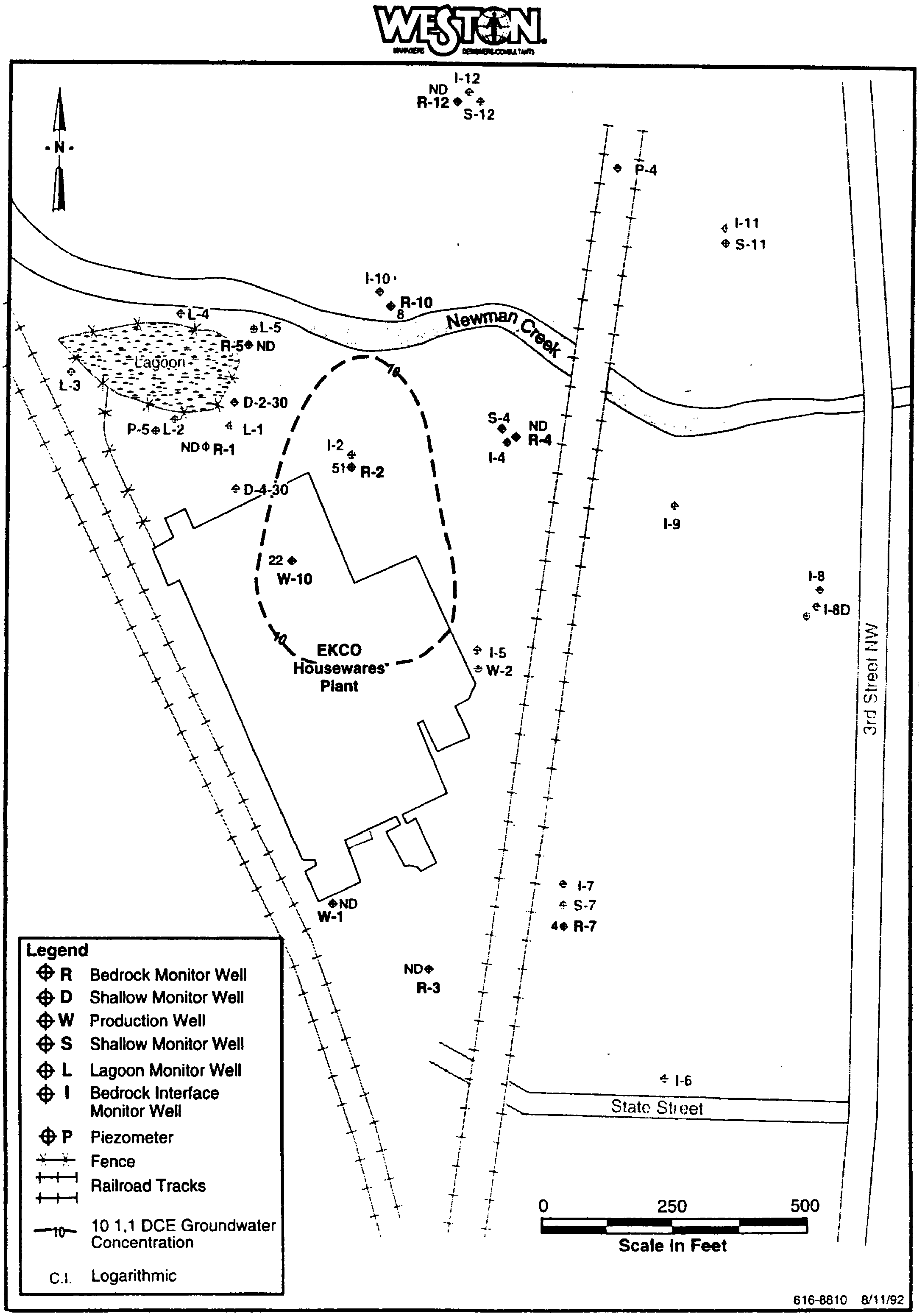

FIGURE 4-43 CONCENTRATION OF 1,1-DICHLOROETHLENE (1,1 DCE) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

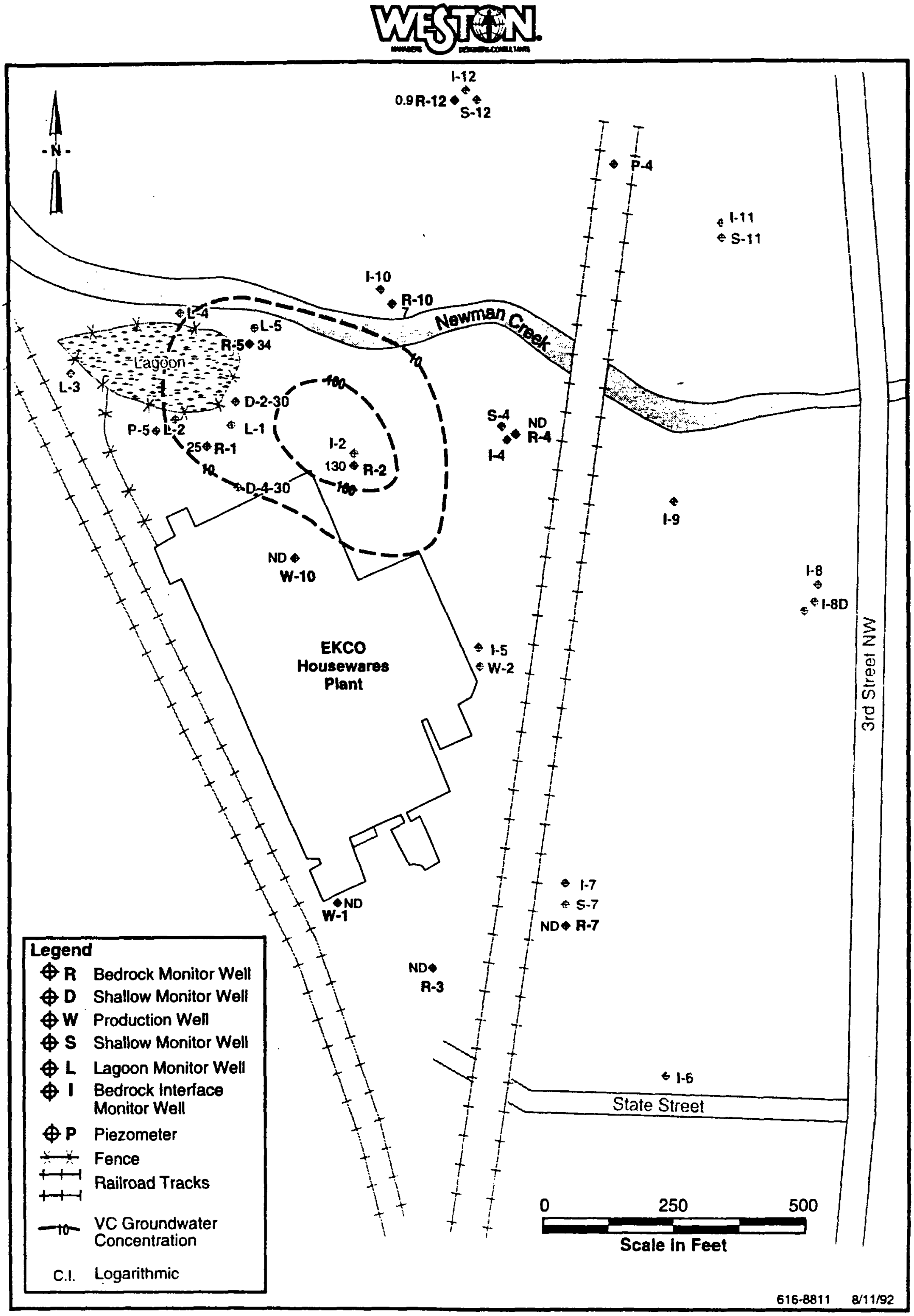

FIGURE 4-44 CONCENTRATION OF VINYL CHLORIDE IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

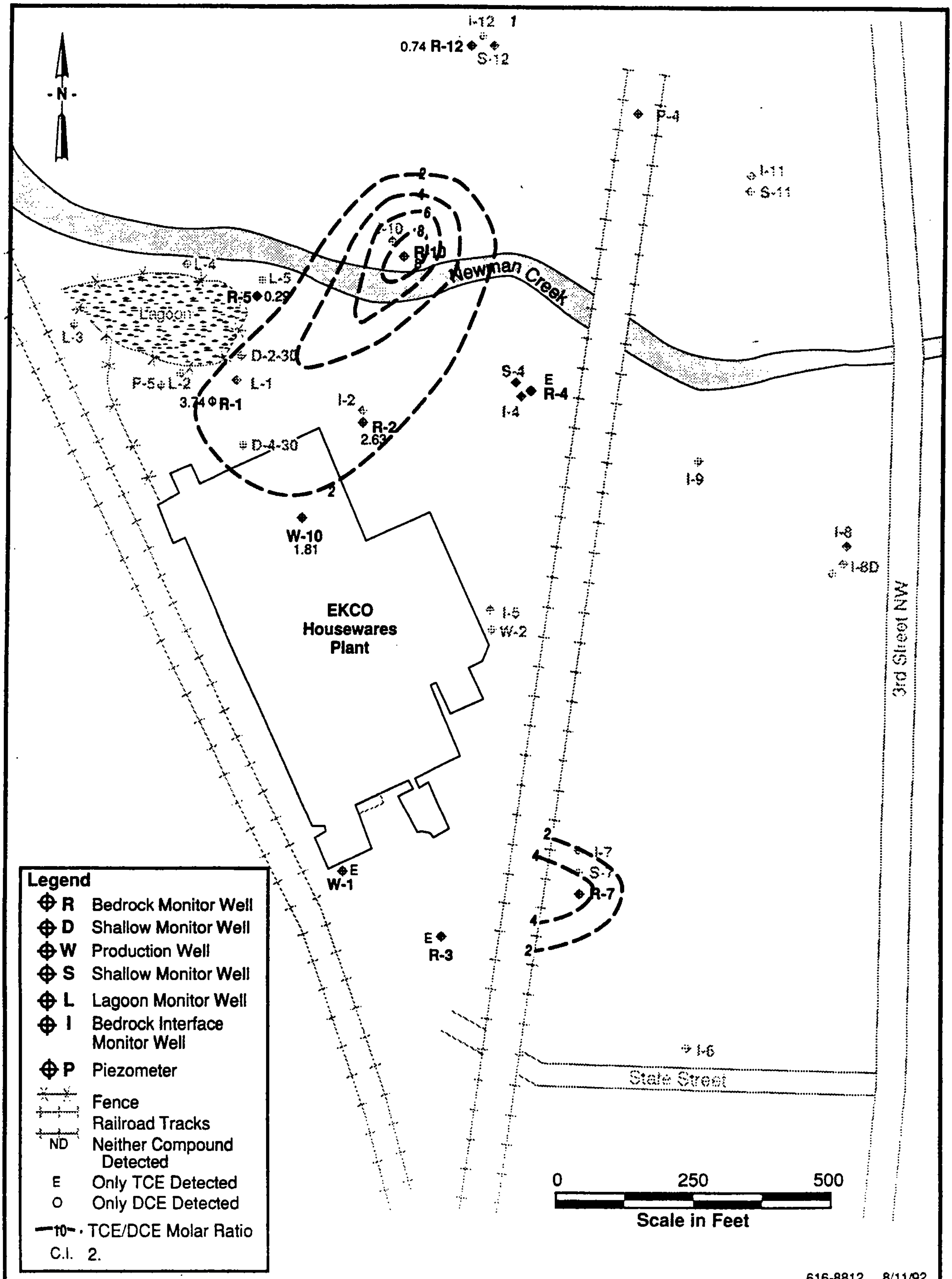

FIGURE 4-45 MOLAR RATIOS OF TRICHOROETHENE TO TOTAL DICHLOROETHENE(TCE/DCE) IN GROUNDWATER FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

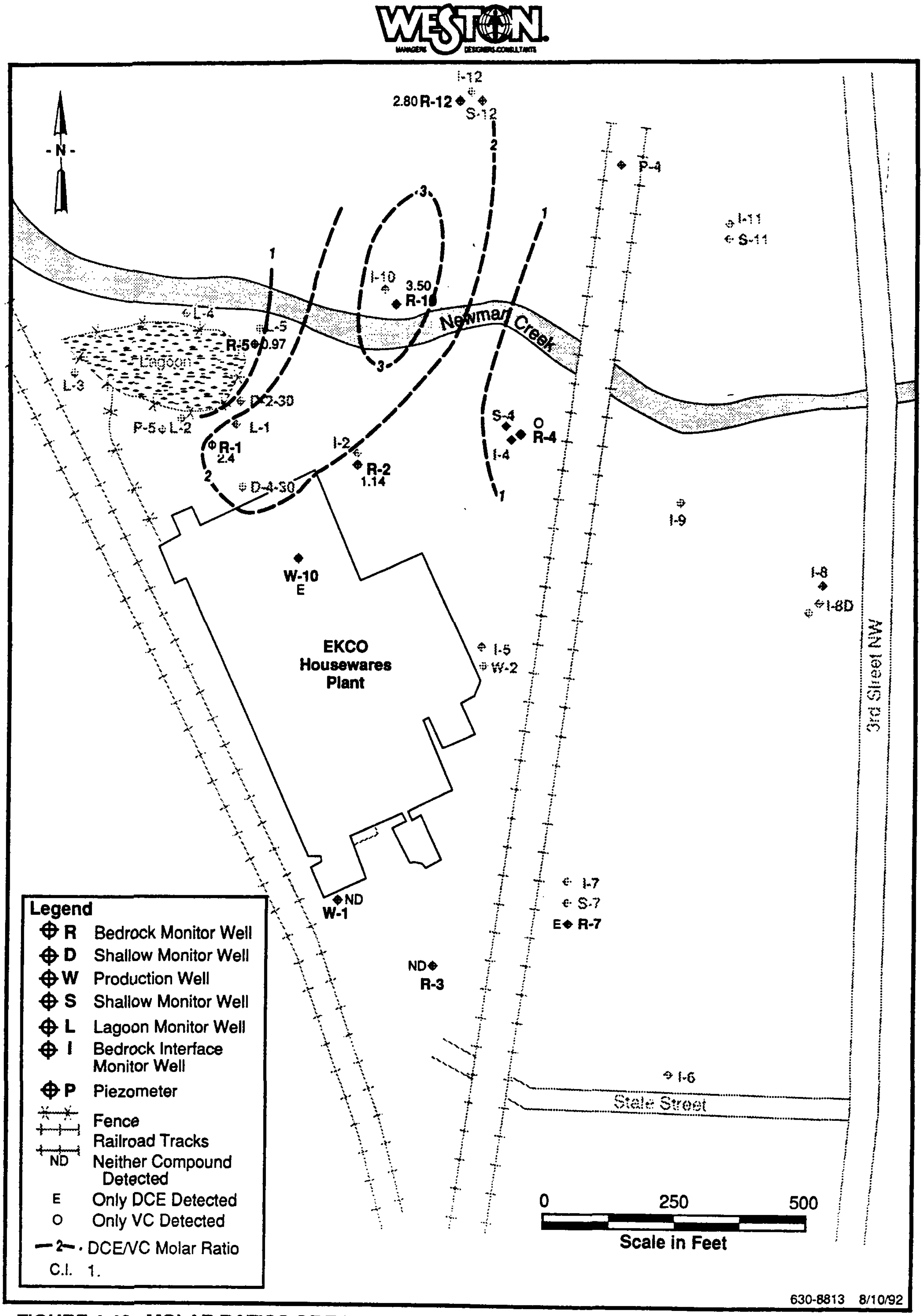

FIGURE 4-46 MOLAR RATIOS OF TOTAL DICHLOROETHENE TO VINYL CHLORIDE (DCE/VC) IN GROUNDWATER FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

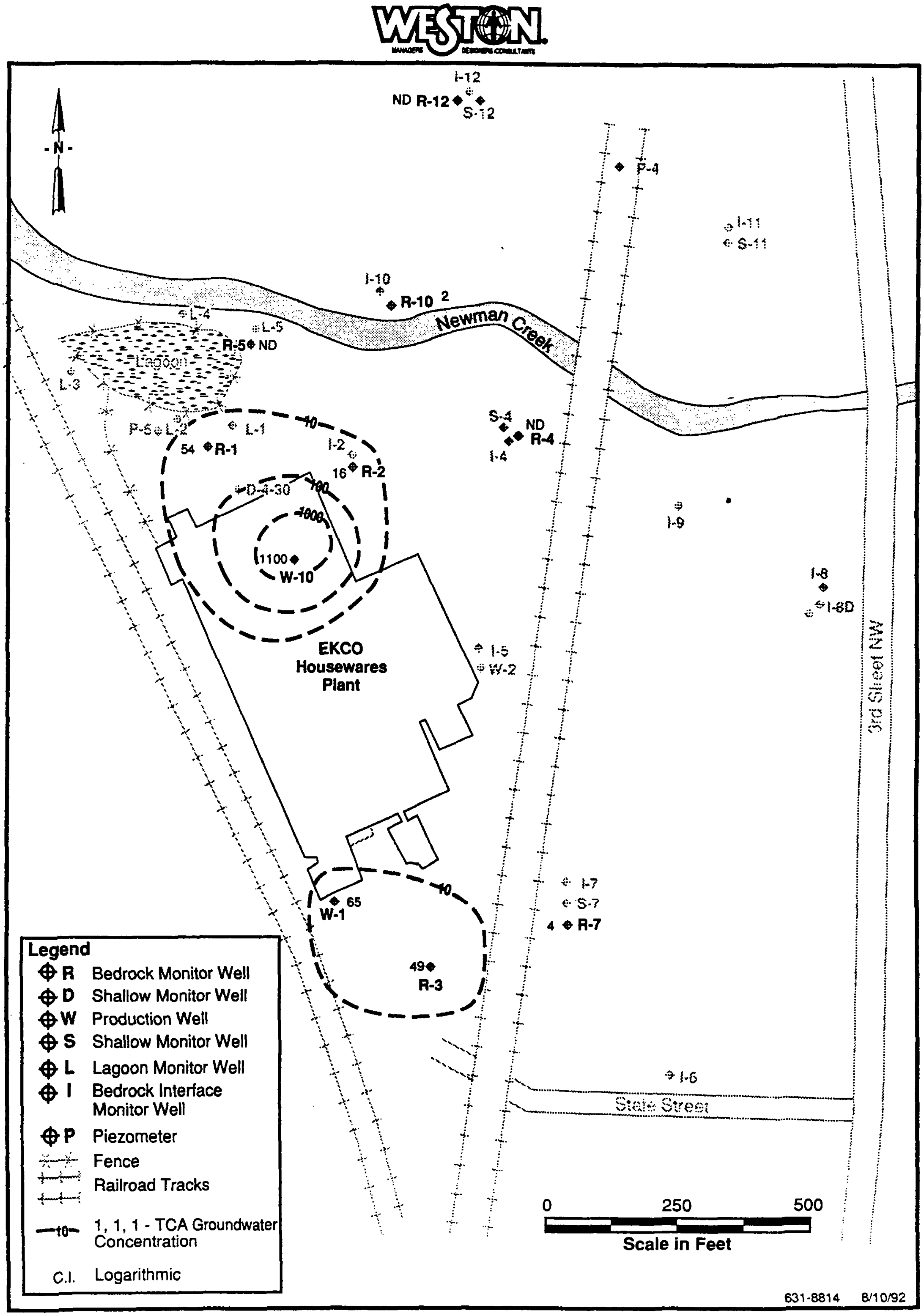

FIGURE 4-47 CONCENTRATION OF 1, 1, 1 - TRICHLOROETHANE (1, 1, 1 - TCA) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991

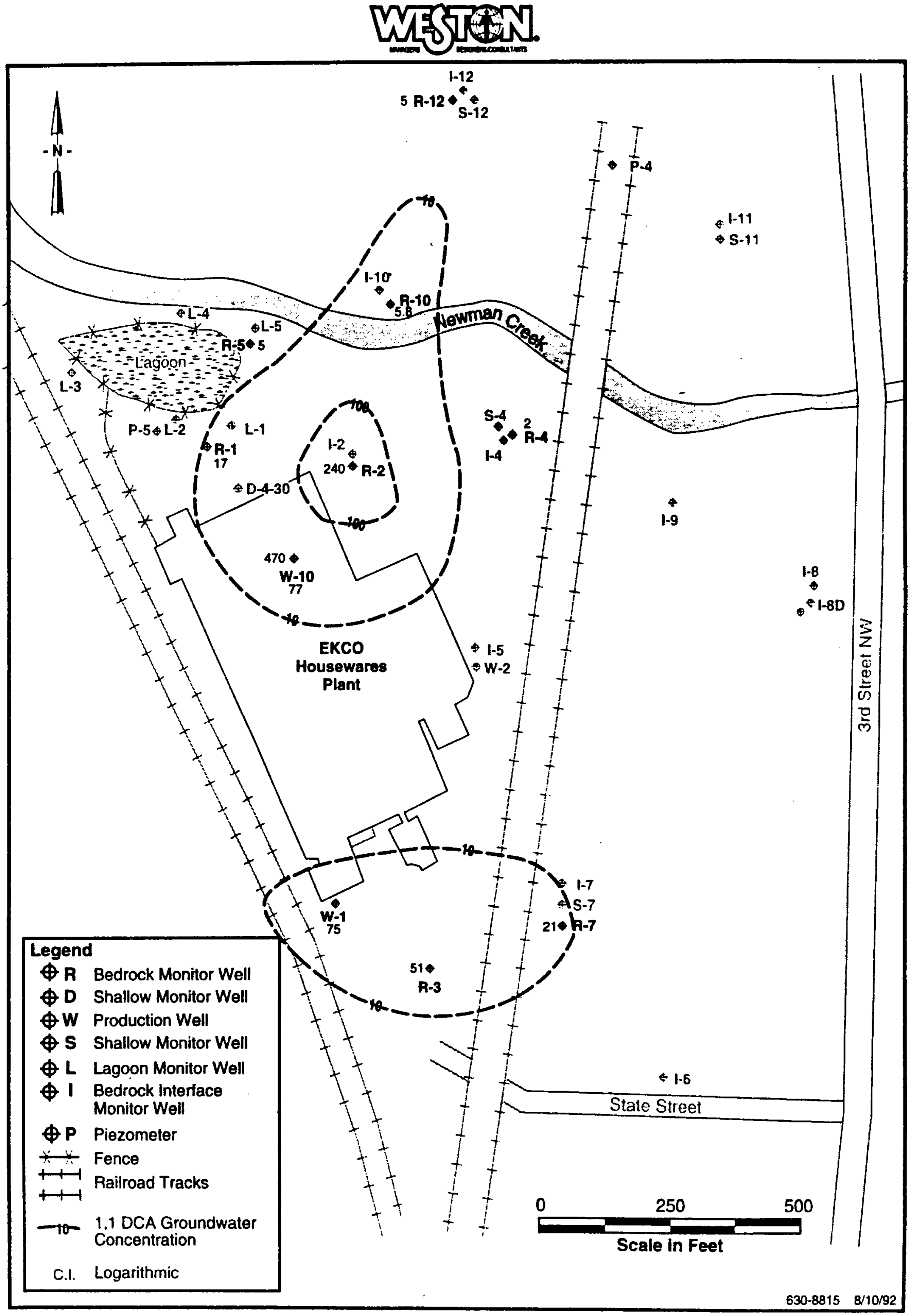

FIGURE 4-48 CONCENTRATION OF 1,1-DICHLOROETHANE (1.1-DCA) IN GROUNDWATER (PPB) FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, OHIO

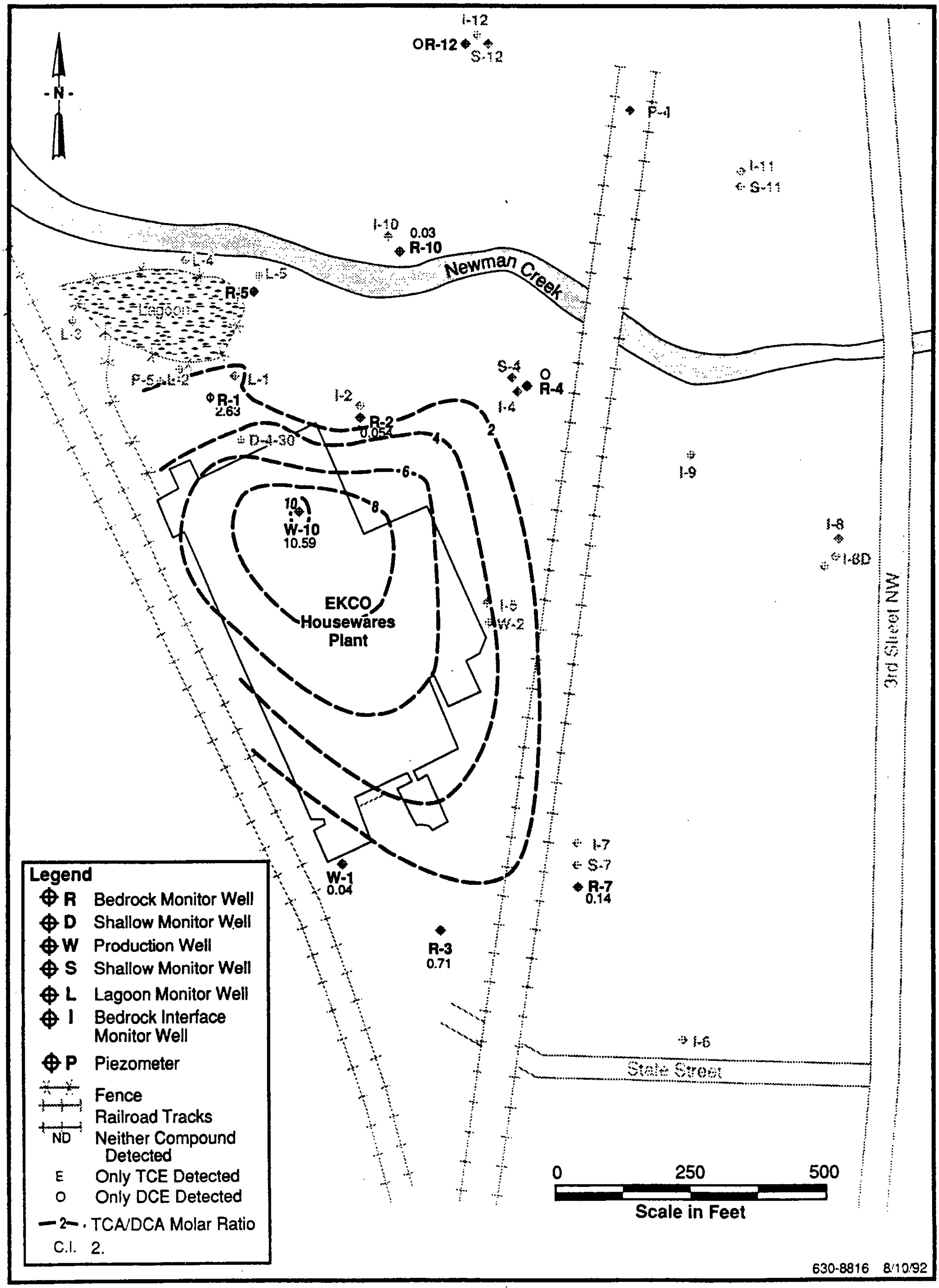

FIGURE 4-49 MOLAR RATIOS OF TOTAL TRICHLOROETHANE TO DICHLOROETHANE (TCA/DCA) IN GROUNDWATER FOR WELLS SCREENED IN BEDROCK WATER BEARING UNIT. WELLS WERE SAMPLED SEPTEMBER 1991, EKCO

plume and closer to the source. Conversely, there is a low 1,1,1-TCA/1,1-DCA ratio (less than one) in the other bedrock wells, indicating that these wells are in a relatively more mature portion of the plume and farther from the source.

4.7.2 Inorganics Groundwater Sampling Results

In December 1988 all of the existing wells were sampled for metals. In September 1991 and March 1992, during the RFI, all of the new wells were sampled for metals. The metals groundwater sampling results for these sampling activities, along with the available MCLs, are shown on Tables 4-10 through 4-13. These tables show that no samples had metals concentrations above the currently existing MCLs. In December 1988, well W-10 had a cadmium concentration of 0.0055 mg/L, which slightly exceeds the MCL of 0.005 mg/L. A duplicate sample was also collected and analyzed for well W-10, and it reported no cadmium detected. All other inorganic groundwater samples collected at the EKCO facility during the groundwater quality assessment and the RFI were below available MCLs.

4.8 TANK TIGHTNESS TESTING RESULTS

Tank tightness testing was performed on tanks 2 through 5 at the EKCO facility in March 1991. Prior to testing tanks 3 and 5, it was confirmed that neither tank had been used; when swabbed, no material other then rust was evidenced. All four tanks had leak rates less than or equal to 0.05 gallon per hour. For Tank 2, the system tested tight at 38 inches above the top of the tank. Tank 3 tested tight at 40 inches above the top of the tank. Tank 4 tested tight at 36 inches and Tank 5 at 38 inches. A summary of the leak testing results is shown in the Table 4-14.

Table 4-10

Shallow Groundwater Inorganics Sampling Results (mg/l)

Shallow ANALYTE	MCL (MG/L)	S-4 12/88	S-4 9/91	S-4 3/92	S-11 12/88	S-11 9/91	S-11 3/92	S-12 12/88	S-12 9/91	S-12 3/92	L-1 12/88	L-1 9/91	L-1 2/92
Aluminum	*	ND	ND	ND	NS	ND	ND	NS	ND	ND	ND	NS	NA
Arsenic	0.05	ND	0.0051	ND	NS	0.011	0.0045	NS	0.008	ND	ND	NS	ND
Barium	1	ND	0.064	0.0064	NS	0.089	0.057	NS	0.2	0.17	ND	NS	ND
Beryllium	0.001	ND	ND	ND	NS	ND	ND	NS	0.0006	ND	ND	NS	NA
Calcium	*	59.2	90.8	103	NS	104	95.2	NS	145	132	219	NS	NA
Cadmium	0.005	ND	0.0024	ND	NS	ND	ND	NS	ND	ND	ND	NS	ND
Cobalt	*	ND	0.0031	ND	NS	0.0029	ND	NS	ND	ND	ND	NS	NA
Chromium	0.1	0.01	ND	ND	NS	ND	ND	NS	ND	ND	ND	NS	ND
Copper	*	ND	0.0044	ND	NS	0.0045	ND	NS	0.0036	ND	ND	NS	NA
Iron	*	1.26	0.024	0.022	NS	3.5	3.9	NS	0.046	0.019	1.12	NS	NA
Mercury	0.002	ND	0.0002	ND	NS	ND	ND	NS	ND	0.0011	ND	NS	ND
Potassium	*	5.72	4.5	4.3	NS	1.3	1.6	NS	18.1	20.3	11.7	NS	NA
Magnesium	*	25.2	20.7	24.4	NS	23.4	19.5	NS	21.4	18.4	46	NS	NA
Manganese	*	0.242	0.2	0.2	NS	0.7	0.35	NS	0.018	0.016	5.59	NS	NA
Sodium	*	104	24.9	26.1	NS	5.6	3	NS	37.1	44.4	29.6	NS	NA
Nickel	*	ND	0.012	0.021	NS	0.013	ND	NS	0.01	0.033	0.125	NS	NA
Lead	0.05	ND	ND	ND	NS	ND	ND	NS	ND	ND	ND	NS	ND
Antimony	*	ND	ND	ND	NS	ND	ND	NS	0.014	ND	ND	NS	NA
Vanadium	*	ND	ND	ND	NS	ND	ND	NS	0.0039	ND	ND	NS	NA
Zinc	*	0.121	0.0064	0.0057	NS	0.015	0.0036	NS	0.01	0.012	ND	NS	NA
Thallium	*	ND	ND	ND	NS	ND	ND	NS	ND	ND	ND	NS	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4–10

Shallow Groundwater Inorganics Sampling Results (mg/l) (continued)

Shallow ANALYTE	MCL (MG/L)	L–2 12/88	L–2 9/91	L–2 2/92	L–3 12/88	L–3 9/91	L–3 2/92	L–4 12/88	L–4 9/91	L–4 2/92	L–5 12/88	L–5 9/91	L–5 2/92
Aluminum	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Arsenic	0.05	ND	NS	0.0074	ND	NS	ND	0.013	NS	0.018	ND	NS	ND
Barium	1	ND	NS	0.063	ND	NS	ND	ND	NS	0.2	ND	NS	ND
Beryllium	0.001	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Calcium	*	124	NS	NA	53.8	NS	NA	84.2	NS	NA	93.9	NS	NA
Cadmium	0.005	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND
Cobalt	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Chromium	0.1	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND
Copper	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Iron	*	ND	NS	NA	23.5	NS	NA	0.808	NS	NA	1.04	NS	NA
Mercury	0.002	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND
Potassium	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	6.18	NS	NA
Magnesium	*	27.5	NS	NA	14.4	NS	NA	25.6	NS	NA	20.7	NS	NA
Manganese	*	0.854	NS	NA	4.23	NS	NA	3.53	NS	NA	0.268	NS	NA
Sodium	*	31.6	NS	NA	8.73	NS	NA	44.6	NS	NA	52.1	NS	NA
Nickel	*	0.043	NS	NA	ND	NS	NA	NA	NS	NA	ND	NS	NA
Lead	0.05	ND	NS	ND	ND	NS	ND	ND	NS	ND	0.006	NS	ND
Antimony	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Vanadium	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Zinc	*	ND	NS	NA	ND	NS	NA	ND	NS	NA	ND	NS	NA
Thallium	*	ND	NS	ND	ND	NS	ND	ND	NS	ND	ND	NS	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4-10

Shallow Groundwater Inorganics Sampling Results (mg/l) (continued)

Shallow ANALYTE	MCL (MG/L)	S-7 12/88	S-7 9/91	S-7 3/92	D-4-30 12/88	D-4-30 9/91	D-4-30 3/92	I-2 12/88	I-2 9/91	I-2 3/92
Aluminum	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Arsenic	0.05	ND	NS	NS	ND	NS	NS	0.005	NS	NS
Barium	1	ND	NS	NS	ND	NS	NS	ND	NS	NS
Beryllium	0.001	ND	NS	NS	ND	NS	NS	ND	NS	NS
Calcium	*	22.6	NS	NS	104	NS	NS	133	NS	NS
Cadmium	0.005	ND	NS	NS	ND	NS	NS	ND	NS	NS
Cobalt	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Chromium	0.1	ND	NS	NS	ND	NS	NS	ND	NS	NS
Copper	*	ND	NS	NS	0.034	NS	NS	ND	NS	NS
Iron	*	ND	NS	NS	ND	NS	NS	3.62	NS	NS
Mercury	0.002	ND	NS	NS	ND	NS	NS	ND	NS	NS
Potassium	*	10	NS	NS	ND	NS	NS	8.64	NS	NS
Magnesium	*	9.01	NS	NS	16	NS	NS	17.9	NS	NS
Manganese	*	0.141	NS	NS	1.17	NS	NS	2.12	NS	NS
Sodium	*	74.4	NS	NS	6.22	NS	NS	28.8	NS	NS
Nickel	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Lead	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS
Antimony	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Vanadium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Zinc	*	ND	NS	NS	ND	NS	NS	ND	NS	NS
Thallium	*	ND	NS	NS	0.004	NS	NS	ND	NS	NS

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4–11

Intermediate Groundwater Inorganics Sampling Results (mg/L)

Intermediate ANALYTE	MCL (MG/L)	I–2			I–4			I–5			I–7		
		12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
Aluminum	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Arsenic	0.05	0.005	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Barium	1	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Beryllium	0.001	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Calcium	*	133	NS	NS	37.8	NS	NS	47	NS	NS	96.2	NS	NS
Cadmium	0.005	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Cobalt	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Chromium	0.1	ND	NS	NS	0.012	NS	NS	ND	NS	NS	ND	NS	NS
Copper	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Iron	*	3.62	NS	NS	ND	NS	NS	ND	NS	NS	5.47	NS	NS
Mercury	0.002	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Potassium	*	8.64	NS	NS	12.2	NS	NS	8.92	NS	NS	5.02	NS	NS
Magnesium	*	17.9	NS	NS	19.1	NS	NS	12.8	NS	NS	24.8	NS	NS
Manganese	*	2.12	NS	NS	0.128	NS	NS	0.151	NS	NS	0.672	NS	NS
Sodium	*	28.8	NS	NS	36.8	NS	NS	32.9	NS	NS	36.9	NS	NS
Nickel	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Lead	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Antimony	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Vanadium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Zinc	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Thallium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS

* = No MCL currently exists.

Notes:
ND = Not detected.
NS = Not sampled.
NA = Not analyzed.

Table 4-11

Intermediate Groundwater Inorganics Sampling Results (mg/L) (continued)

Intermediate ANALYTE	MCL (MG/L)	I-8 12/88	I-8 9/91	I-8 3/92	I-10 12/88	I-10 9/91	I-10 3/92	I-12 12/88	I-12 9/91	I-12 3/92
Aluminum	*	ND	ND	NS	NS	0.077	ND	NS	0.055	ND
Arsenic	0.05	ND	0.0008	NS	NS	0.0024	ND	NS	0.0009	ND
Barium	1	ND	ND	NS	NS	0.092	0.089	NS	0.036	0.11
Beryllium	0.001	ND	ND	NS	NS	0.0006	0.0006	NS	NA	0.0007
Calcium	*	22.6	ND	NS	NS	97.3	86.6	NS	38.4	126
Cadmium	0.005	ND	ND	NS	NS	ND	ND	NS	ND	ND
Cobalt	*	ND	ND	NS	NS	ND	ND	NS	ND	ND
Chromium	0.1	ND	ND	NS	NS	ND	ND	NS	ND	ND
Copper	*	ND	0.0058	NS	NS	0.0025	ND	NS	0.0031	ND
Iron	*	ND	0.12	NS	NS	0.086	0.099	NS	0.022	0.2
Mercury	0.002	ND	ND	NS	NS	ND	ND	NS	ND	ND
Potassium	*	6.19	ND	NS	NS	3.2	2.6	NS	88.6	14.9
Magnesium	*	9.01	0.063	NS	NS	21.8	19.9	NS	10.8	20.6
Manganese	*	0.027	0.0027	NS	NS	0.73	0.66	NS	0.14	0.62
Sodium	*	32.3	0.58	NS	NS	70.1	58	NS	71.3	38.1
Nickel	*	ND	ND	NS	NS	0.0065	ND	NS	0.0067	ND
Lead	0.05	ND	ND	NS	NS	ND	ND	NS	ND	ND
Antimony	*	ND	ND	NS	NS	ND	ND	NS	ND	ND
Vanadium	*	ND	ND	NS	NS	0.0029	ND	NS	ND	ND
Zinc	*	0.024	0.0096	NS	NS	0.0088	0.006	NS	0.0076	0.0066
Thallium	*	ND	ND	NS	NS	ND	ND	NS	ND	ND

* = No MCL currently exists.

Notes:
ND = Not detected.
NS = Not sampled.
NA = Not analyzed.

Table 4–12

Deep Groundwater Inorganics Sampling Results (mg/l)

Deep ANALYTE	MCL (MG/L)	I–6			I–8D			I–9		
		12/88	9/91	3/92	12/88	9/91	3/92	12/88	9/91	3/92
Aluminum	*	ND	NS	NS	NS	ND	ND	NS	0.033	ND
Arsenic	0.05	ND	NS	NS	NS	0.0063	0.0041	NS	0.0046	ND
Barium	1	ND	NS	NS	NS	0.036	0.03	NS	0.048	0.042
Beryllium	0.001	ND	NS	NS	NS	ND	0.0008	NS	ND	0.0008
Calcium	*	44.5	NS	NS	NS	134	144	NS	178	164
Cadmium	0.005	ND	NS	NS	NS	ND	ND	NS	ND	ND
Cobalt	*	ND	NS	NS	NS	ND	ND	NS	ND	ND
Chromium	0.1	ND	NS	NS	NS	ND	ND	NS	ND	ND
Copper	*	ND	NS	NS	NS	ND	ND	NS	0.0026	ND
Iron	*	ND	NS	NS	NS	2.3	2.3	NS	2	0.063
Mercury	0.002	0.0012	NS	NS	NS	0.00043	ND	NS	0.00037	0.00021
Potassium	*	7.38	NS	NS	NS	3.1	2.1	NS	5.2	7.1
Magnesium	*	18.5	NS	NS	NS	34.3	35.5	NS	26.6	26.7
Manganese	*	0.319	NS	NS	NS	0.28	0.3	NS	0.35	0.26
Sodium	*	35.6	NS	NS	NS	86.4	52.6	NS	97.1	96.4
Nickel	*	ND	NS	NS	NS	0.006	ND	NS	ND	0.13
Lead	0.05	ND	NS	NS	NS	ND	ND	NS	ND	ND
Antimony	*	ND	NS	NS	NS	0.015	ND	NS	ND	ND
Vanadium	*	ND	NS	NS	NS	ND	ND	NS	ND	ND
Zinc	*	ND	NS	NS	NS	0.02	0.0091	NS	0.029	0.028
Thallium	*	ND	NS	NS	NS	ND	ND	NS	ND	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4–12

Deep Groundwater Inorganics Sampling Results (mg/l)

Deep ANALYTE	MCL (MG/L)	I–11 12/88	I–11 9/91	I–11 3/92	I–13 12/88	I–13 9/91	I–13 3/92	I–14 12/88	I–14 9/91	I–14 3/92
Aluminum	*	NS	ND	ND	NS	ND	ND	NS		ND
Arsenic	0.05	NS	ND	0.0034	NS	0.0016	0.0029	NS	0.0021	0.0069
Barium	1	NS	0.051	0.047	NS	0.057	0.046	NS	0.028	0.083
Beryllium	0.001	NS	ND	0.0006	NS	ND	0.0008	NS	0.0006	ND
Calcium	*	NS	145	137	NS	83.7	143	NS	20.6	111
Cadmium	0.005	NS	ND	ND	NS	ND	ND	NS	ND	ND
Cobalt	*	NS	ND	ND	NS	ND	ND	NS	ND	ND
Chromium	0.1	NS	ND	ND	NS	0.0073	ND	NS	ND	ND
Copper	*	NS	ND	ND	NS	0.0078	ND	NS	0.0025	ND
Iron	*	NS	1.8	2	NS	ND	0.72	NS	0.017	1.1
Mercury	0.002	NS	ND	ND	NS	ND	ND	NS	ND	0.00022
Potassium	*	NS	4.2	4.2	NS	18.8	3.3	NS	29.4	1.5
Magnesium	*	NS	26.9	25.3	NS	3.9	23.4	NS	21	30.2
Manganese	*	NS	0.37	0.35	NS	ND	0.4	NS	0.013	0.3
Sodium	*	NS	65.8	69	NS	90.3	96.8	NS	44.7	20.6
Nickel	*	NS	ND	ND	NS	ND	ND	NS	0.0061	ND
Lead	0.05	NS	ND	ND	NS	ND	ND	NS	ND	ND
Antimony	*	NS	ND	ND	NS	ND	ND	NS	ND	ND
Vanadium	*	NS	ND	ND	NS	ND	ND	NS	ND	ND
Zinc	*	NS	0.0085	0.005	NS	0.0053	0.0061	NS	ND	0.0045
Thallium	*	NS	ND	ND	NS	ND	ND	NS	ND	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4–13

Bedrock Groundwater Inorganics Sampling Results (mg/l)

Bedrock ANALYTE	MCL (MG/L)	W-1 12/88	W-1 9/91	W-1 3/92	W-10 12/88	W-10 9/91	W-10 3/92	R-1 12/88	R-1 9/91	R-1 2/92	R-2 12/88	R-2 9/91	R-2 2/92
Aluminum	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Arsenic	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Barium	1	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Beryllium	0.001	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Calcium	*	95.5	NS	NS	102	NS	NS	85.4	NS	NS	167	NS	NS
Cadmium	0.005	ND	NS	NS	0.0055	NS	NS	ND	NS	NS	ND	NS	NS
Cobalt	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Chromium	0.1	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Copper	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Iron	*	0.115	NS	NS	ND	NS	NS	0.482	NS	NS	1.49	NS	NS
Mercury	0.002	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Potassium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	7.71	NS	NS
Magnesium	*	25.1	NS	NS	25.5	NS	NS	24	NS	NS	31.9	NS	NS
Manganese	*	0.613	NS	NS	0.753	NS	NS	1.12	NS	NS	1.29	NS	NS
Sodium	*	33.8	NS	NS	29.4	NS	NS	43.6	NS	NS	32.9	NS	NS
Nickel	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Lead	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Antimony	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Vanadium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS
Zinc	*	0.033	NS	NS	0.06	NS	NS	0.046	NS	NS	ND	NS	NS
Thallium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	ND	NS	NS

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4-13, (Continued)

Bedrock Groundwater Inorganics Sampling Results (mg/l)

Bedrock ANALYTE	MCL (MG/L)	R-3 12/88	R-3 9/91	R-3 2/92	R-4 12/88	R-4 9/91	R-4 2/92	R-5 12/88	R-5 9/91	R-5 3/92	R-7 12/88	R-7 9/91	R-7 2/92
Aluminum	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Arsenic	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	0.003	0.0021
Barium	1	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	0.067	0.058
Beryllium	0.001	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Calcium	*	124	NS	NS	23	NS	NS	137	NS	NS	NS	86.5	85.7
Cadmium	0.005	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Cobalt	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Chromium	0.1	ND	NS	NS	0.012	NS	NS	ND	NS	NS	NS	ND	ND
Copper	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	0.0032	ND
Iron	*	ND	NS	NS	ND	NS	NS	3.52	NS	NS	NS	0.35	0.32
Mercury	0.002	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Potassium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	4	3.1
Magnesium	*	31.3	NS	NS	19	NS	NS	33	NS	NS	NS	21.3	21
Manganese	*	0.539	NS	NS	0.138	NS	NS	0.734	NS	NS	NS	0.45	0.33
Sodium	*	27.8	NS	NS	43.9	NS	NS	64.5	NS	NS	NS	27.6	26.3
Nickel	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Lead	0.05	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Antimony	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Vanadium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND
Zinc	*	ND	NS	NS	0.02	NS	NS	ND	NS	NS	NS	0.03	0.015
Thallium	*	ND	NS	NS	ND	NS	NS	ND	NS	NS	NS	ND	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4–13, (Continued)

Bedrock Groundwater Inorganics Sampling Results (mg/l)

Bedrock ANALYTE	MCL (MG/L)	R-10 12/88	R-10 9/91	R-10 3/92	R-12 12/88	R-12 9/91	R-12 3/92
Aluminum	*	NS	0.04	ND	NS	0.037	ND
Arsenic	0.05	NS	0.0015	ND	NS	0.0019	ND
Barium	1	NS	0.15	0.11	NS	0.14	0.13
Beryllium	0.001	NS	0.0006	ND	NS	0.0005	ND
Calcium	*	NS	119	113	NS	114	108
Cadmium	0.005	NS	ND	ND	NS	ND	ND
Cobalt	*	NS	0.0087	ND	NS	ND	0.0034
Chromium	0.1	NS	ND	ND	NS	ND	ND
Copper	*	NS	0.0062	0.0028	NS	0.0045	ND
Iron	*	NS	0.13	0.048	NS	0.054	0.3
Mercury	0.002	NS	ND	ND	NS	ND	ND
Potassium	*	NS	4	3.8	NS	11.6	6.1
Magnesium	*	NS	28.4	27.3	NS	22.9	22.6
Manganese	*	NS	1.5	1.4	NS	0.71	0.58
Sodium	*	NS	36.1	31.5	NS	39.4	34.9
Nickel	*	NS	0.012	ND	NS	0.01	0.016
Lead	0.05	NS	ND	ND	NS	ND	ND
Antimony	*	NS	ND	ND	NS	0.015	ND
Vanadium	*	NS	0.0085	ND	NS	0.0027	ND
Zinc	*	NS	0.089	0.018	NS	0.2	0.0059
Thallium	*	NS	ND	ND	NS	ND	ND

Notes:

* = No Maximum Contaminant Level Currently exists.
ND = Not Detected.
NS = Not Sampled.
NA = Not Analyzed.

Table 4-14

Tank Tightness Testing Results

Tank	Test	Average Leak Rate (gallons/hour)	99% Confidence (gallons/hour)
2	91032097.A38	-0.03	0.00
3	91032094.B40	-0.01	0.01
4	91032086.A36	0.05	0.03
5	91032087.B38	0.00	0.00

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SECTION 5
SUMMARY

This section presents a summary of the geology, hydrogeology, and geochemistry and an evaluation of the current groundwater remediation system at the EKCO facility.

5.1 GEOLOGY SUMMARY

The EKCO facility is situated on the western flank of a glacial valley that extends to the north and south and was carved from Pennsylvanian age sedimentary rocks during the Pleistocene glaciation. Prior to the construction of the facility in 1945, a cover of fill material was used to level the natural glacially-formed topography at the building site. The glacially deposited sediments form a thin veneer less than 20 ft thick in the western portion of the site where bedrock is shallow. In the eastern portion of the site, the sediments infill the glacial valley, reaching a maximum thickness of greater than 252 ft (see Figure 4-19).

Based on the vertical distribution of the glacial sediments encountered during drilling, seven separate layers of unconsolidated material were identified and correlated between monitor wells at the site. Three high permeability sand and gravel units were identified, separated by four low permeability silt and clay units. Underlying the glacial sediments, bedrock is encountered at its highest elevation in the northwestern portion of the site and slopes to the east at an approximate 17° angle (see Figure 4-25). Bedrock encountered at the site consists of four interbedded layers. The shallowest bedrock unit encountered consists of an interbedded low permeable shale and argillaceous sandstone, which is underlain by a high permeable, well sorted sandstone (see Figure 4-1). The sandstone unit is the primary bedrock water bearing unit at the site. Below the sandstone is another low permeable interbedded shale and argillaceous sandstone unit, which is directly underlain by shale.

5.2 HYDROGEOLOGY SUMMARY

The vertical stratigraphy at the site is divided into four distinct permeable hydrostratigraphic units, i.e., shallow sand and gravel, intermediate sand and gravel, deep sand and gravel, and sandstone bedrock. These high permeable units are separated by low permeable clay and silt or shale and argillaceous sandstone. In general, the sand and gravel and the sandstone units act as the primary medium for groundwater flow and the low permeable silt, clay, shale and argillaceous sandstone act as barriers to groundwater flow, however variations in permeability occur locally. There are five groundwater production wells in the area of the site, which have an effect on the groundwater flow system. EKCO uses the two sandstone bedrock production wells, W-1 and W-10, pumping at a total of approximately 600 gpm to provide water for the manufacturing facility. OWS pumps the three production wells (OWS-1, -2, and -3) intermittently from the deep sand and gravel up to 2,800 gpm to provide water for the City of Massillon. The packer test results indicate that the casing seal is leaking in well R-2 and probably also in wells R-1, R-3, and R-4. The leaking seal provides a direct conduit for the migration of groundwater and VOC from the overburden to the sandstone.

Groundwater contour maps for the site indicate that the pumping of the EKCO production wells W-1 and W-10 appreciably affects the groundwater flow in the shallow, intermediate, and the bedrock water-bearing zones. A drawdown cone exists in these three units around wells W-1 and W-10. As a result of the pumping, the groundwater in the shallow, intermediate, and bedrock water-bearing zones under the entire site is flowing directly toward production wells W-1 and W-10, and does not flow off-site (Figures 4-26, 4-27, and 4-29). Groundwater in the deep sand and gravel water bearing unit (which is present adjacent to the facility but not under it) flows directly north toward the pumping OWS production wells OWS-1, -2, and -3 (see Figure 4-28).

5.3 GEOCHEMISTRY

5.3.1 Source Identification

Based on soil borings advanced in 1988 and 1991, the following three VOC source areas were identified and are displayed on Figure 5-1:

- Tank area at southwestern end of plant.

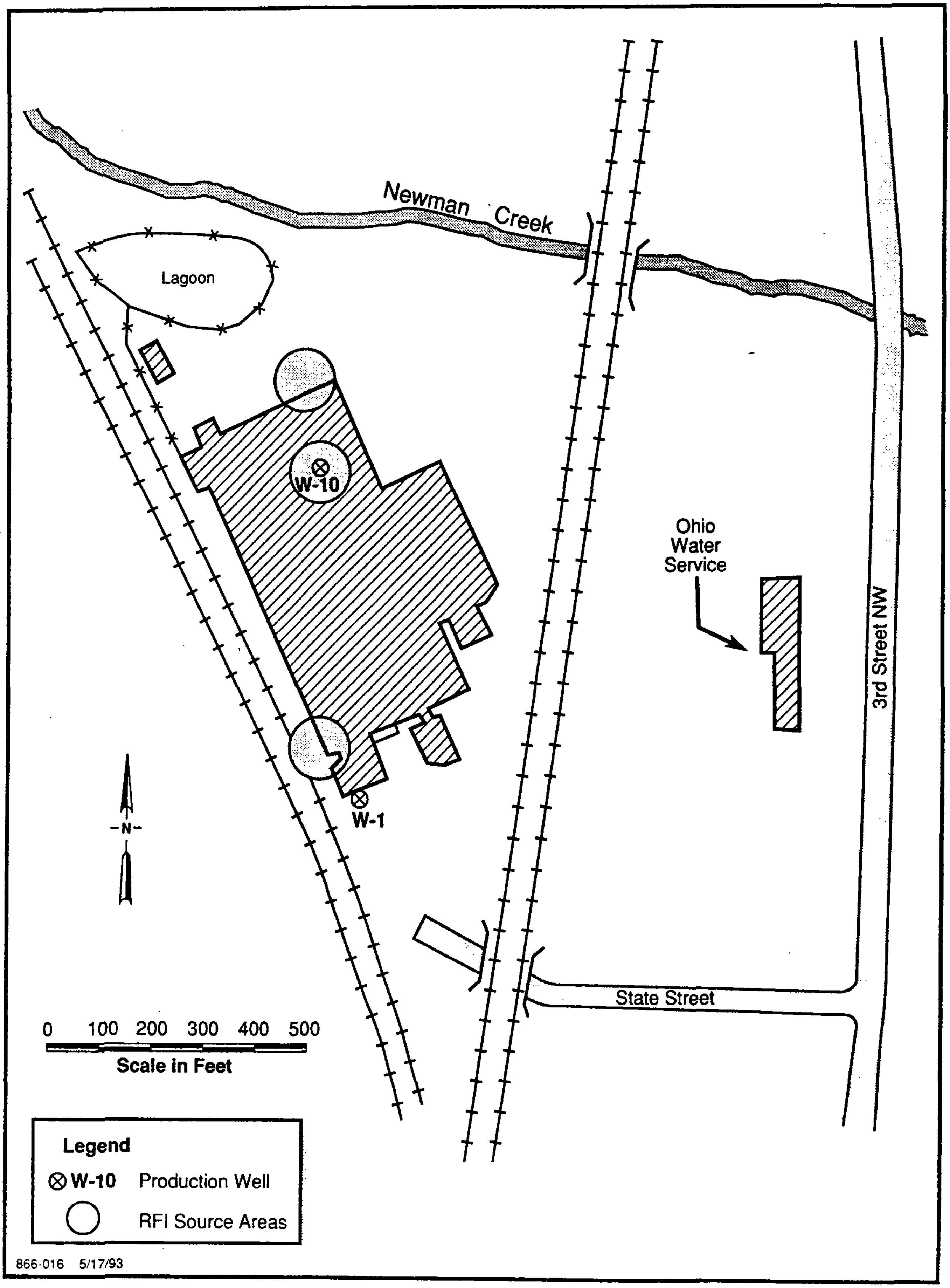

FIGURE 5-1 VOC SOURCE AREAS IDENTIFIED DURING THE RFI

- Sump at production well W-10.
- Tank area at northern end of plant.

Results of the 1988 Groundwater Quality Assessment soil boring and soil gas sampling are included in Appendix A. TCE was the primary constituent detected at the tank area at the southwestern end of plant. TCE contamination was detected at 140 ppm in WESTON's shallow boring and at 2 ppm at 6 to 8 ft in another boring. TCE, TCA, and DCE were among the VOCs detected in the area northeast of the building. Total VOCs detected in one shallow sample were 1.4 ppm. In the tank area at the northern end of the building, TCE and DCE were the primary constituents detected. TCE was detected at all depth intervals in borings installed at the north end of the building. DCE was detected at 34 ppm in one boring installed through the floor of the building.

Four USTs (Tanks 2 through 5) were leak tested and found to be tight.

5.3.2 Groundwater Geochemical Summary

Groundwater sampling was conducted at the EKCO site in December 1988, September 1991, and March 1992. In addition to these three sampling events, selected wells have been sampled quarterly since 1989 as part of a lagoon closure for the site. Groundwater sampling has been conducted for both VOCs and metals.

The VOCs detected in the groundwater were predominantly TCE, 111-TCA, and their respective breakdown products. The results indicate that high concentrations of TCE and 1,1,1-TCA occur in the shallow groundwater near the source area north of the plant near well D-4-30, in the intermediate groundwater at Well I-2, and in the bedrock groundwater near wells W-10, R-1, and R-2. The percentage of breakdown products increases with increasing distance from the source areas at wells W-10 and D-4-30. Groundwater in the shallow, intermediate and bedrock water bearing zones is staying onsite and flowing toward the production wells W-1 and W-10. Any VOCs that exist in the groundwater at the site are being recovered by the site production wells and are being treated by the on-site air stripper system. VOC concentrations in the deep sand and gravel unit were all either near or below primary drinking water standards (MCLs).

Shallow groundwater sampling results indicate that there is a separate and relatively new off-site TCE source approximately 500 ft north of the EKCO site at Well S-12 (Figure 4-30). The exceptionally high level of TCE and the absence of any appreciable breakdown products indicate that it is a fairly recent TCE release and it is unrelated to activities that have occurred at the EKCO site.

No metals concentrations were detected over MCLs (see Tables 4-10 through 4-13).

5.4 EVALUATION OF CURRENT GROUNDWATER REMEDIATION SYSTEM

Four water-bearing units have been identified in the area of the EKCO facility: the shallow, the intermediate, the deep, and the bedrock. Of these only the deep aquifer is not present below the EKCO facility. The groundwater remediation system currently in operation at the EKCO facility consists of the two bedrock wells, W-1 and W-10, pumping at a total flow rate of approximately 600 gpm. The water is then processed through an on-site air stripper system to remove VOC. Groundwater contour maps of the shallow, intermediate and bedrock water bearing units (see Figures 4-26 through 4-29) indicate that the groundwater in these units is flowing toward the production wells, W-1 and W-10. Because all of the groundwater at the facility in these three units is flowing toward the production wells, W-1 and W-10, any VOCs that exist in the groundwater at the facility are being captured by the site production wells and treated by the on-site air stripper system. VOC concentrations for samples collected between 1988 and 1992 from wells completed in the deep unit ranged from less than 1 ppb to 9 ppb (see Table 4-8).

These results of the RFI indicate that no VOC-contaminated groundwater is migrating off-site. Therefore, users of groundwater supplies off-site in the area are not receptors, either actual or potential, for the migration of contaminated groundwater. Results of surface water and sediment samples collected from Newman Creek during the Groundwater Quality

Assessments are presented in Appendix A. These results indicate that discharge of contaminated groundwater to surface waters of Newman Creek was not an issue of further concern.

SECTION 6
CONCLUSIONS

WESTON has conducted environmental investigative activities at the EKCO bakeware manufacturing facility in Massillon, Ohio, since 1987. These activities have included sampling of groundwater, surface water, soil and soil gas, and the completion of 25 soil borings and the installation of 29 groundwater monitor wells. The results of these activities have led to the following conclusions about the hydrogeological and geochemical conditions at the EKCO facility:

- The main on-site sources of VOC contamination are located at recovery well W-10 and the tank area north of the building.
- No groundwater containing VOC concentrations above MCLs is migrating off-site. Groundwater occurs in three water-bearing units at the facility with VOC concentrations above MCLs, i.e., the shallow, the intermediate, and the bedrock units. All the groundwater in these three units is flowing toward and being recovered by the two recovery wells, W-1 and W-10, which pump at a total flow rate of approximately 600 gpm. The recovered groundwater is treated in an air stripper system.
- Tanks 2 through 5 were determined not to be leaking. Tanks 3 and 5 were confirmed to be empty and clean and have not been used for the storage of oil or hazardous substances.
- The groundwater recovery system operating at the facility has lowered the groundwater VOC concentration in some observation wells at the facility as much as an order of magnitude since WESTON sampled them in 1988.
- A separate shallow TCE source that is unrelated to past or present activities at the EKCO facility currently exists approximately 500 ft north of the EKCO property.
- The lagoon is not a source of metals or VOC contamination to the groundwater.
- VOC contamination was identified in the soils at the tank area at the southwestern end of the plant, at the sump at production well W-10, and at the tank area at the northern end of the plant.
- The sewer line from the air stripper to the NPDES outfall has numerous breaks, allowing infiltration of contaminated water as it permeates through the soil. VOC levels, as a result, are higher at the outfall than at the discharge from the air stripper.

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SECTION 7

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APPENDIX A

GROUNDWATER QUALITY ASSESSMENT REPORT

GROUNDWATER QUALITY ASSESSMENT REPORT

FOR EKCO HOUSEWARES, INC.

MASSILLON, OHIO

JANUARY 1990

Prepared By:

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6277B

WESTON

GROUNDWATER QUALITY ASSESSMENT

EKCO HOUSEWARES, INC.

MASSILON, OHIO

JANUARY 1990

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SECTION 1

INTRODUCTION

1.1 PURPOSE AND PROGRAM OBJECTIVES

Groundwater beneath the EKCO Housewares, Inc. (EKCO) plant property contains organic compounds currently listed on the Environmental Protection Agency's (EPA) Hazardous Substance List (HSL), including trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), vinyl chloride and dichlorethylene (DCE). Some of these compounds are associated with plant activities and may have resulted from historic and recent spills and leaks.

The general purpose of the groundwater quality assessment program is to address groundwater conditions at EKCO proceeding under Section 3008 (h) of the Resource Conservation and Recovery Act of 1976, as amended, U.S.C. 6928 (h) and as part of the closure plan for the surface impoundment facility, particularly in reference to 40 CFR Section 265.93. Issues under this section include potential adverse effects on the groundwater beneath the site, the direction of groundwater flow, the proximity of surface waters, existing background quality of groundwater, and possible other sources of contamination. Other issues include the existing quality of surface water hydraulically connected to the lagoon, other sources of contamination to surface water, and current uses of groundwater in the area. The groundwater quality assessment addresses these issues as presented in 40 CFR Section 264.93.

The specific objectives of the groundwater quality assessment program are as follows:

- To evaluate groundwater flow direction.
- To evaluate vertical and lateral extent of groundwater contamination.
- To evaluate the depth and extent of soil contamination. To determine the impact of soil contamination on groundwater quality.
- To identify other sources (present or past) of on-site contaminants to groundwater.
- To evaluate the effectiveness of the presently operating groundwater recovery and air stripping activities relating to removal of organics from the soils and groundwater.
- To evaluate the need for additional efforts to complete the RCRA Facility Investigation (RFI).

- To establish a compliance groundwater monitoring program for the lagoon closure.

The remainder of Section 1 presents background information regarding the EKCO facility and past activities. Section 2 presents a description of field activities undertaken for the groundwater assessment program. Section 3 presents the results of the field investigation as well as the results of data evaluation. Section 4 covers the groundwater flow modeling effort and results. Conclusions are presented in Section 5.

1.2 SITE LOCATION

The EKCO Housewares, Inc. facility occupies approximately 13 acres in the town of Massillon, Stark County, Ohio (Figure 1-1). The area surrounding the site is largely urban and industrial. Land use to the northwest is more rural with a larger proportion of open space. The EKCO property is triangular in shape and lies an estimated 1,500 feet west of the Tuscarawas River. The facility is bordered to the north by Newman Creek, while the Penn Central and the Baltimore and Ohio Railroads border the EKCO property to the west and east, respectively.

A variety of businesses operate adjacent to the EKCO plant. These include Ohio Packaging (paper) to the south, sand and gravel quarries to the west and northwest, Carter Lumber (retail) and American Drain Pipe (concrete pipe) to the north and the Ohio Water Service (public water supply) waterworks to the east. A relatively large inactive municipal landfill exists just east of the Ohio Water Service facility. The landfill is believed to have been principally used by the city of Massillon; however, other users may also have been involved. The landfill was apparently informally operated, that is, no weight station or access control was believed to have been present, and the area was not fenced. It is unclear whether records of ownership, methods of operation, or methods of "closure" have been retained. The Baltimore and Ohio Railroad has numerous spurs and sidetracks adjacent to the EKCO plant which are used for the storage of rail cars and track maintenance vehicles.

1.3 SITE HISTORY

In 1945, the Massillon EKCO facility was manufacturing aluminum and stainless steel cookware. By 1951, with the United States' involvement in the Korean Conflict, the plant was manufacturing 90mm and 105mm shell casings for the military. The resulting increase in production necessitated the drilling of two production wells (W-1 and W-2) at the facility. In 1953, a sewer was constructed which carried the plant waste to a discharge point along Newman Creek. At approximately this same time, a surface impoundment was constructed along the northern property

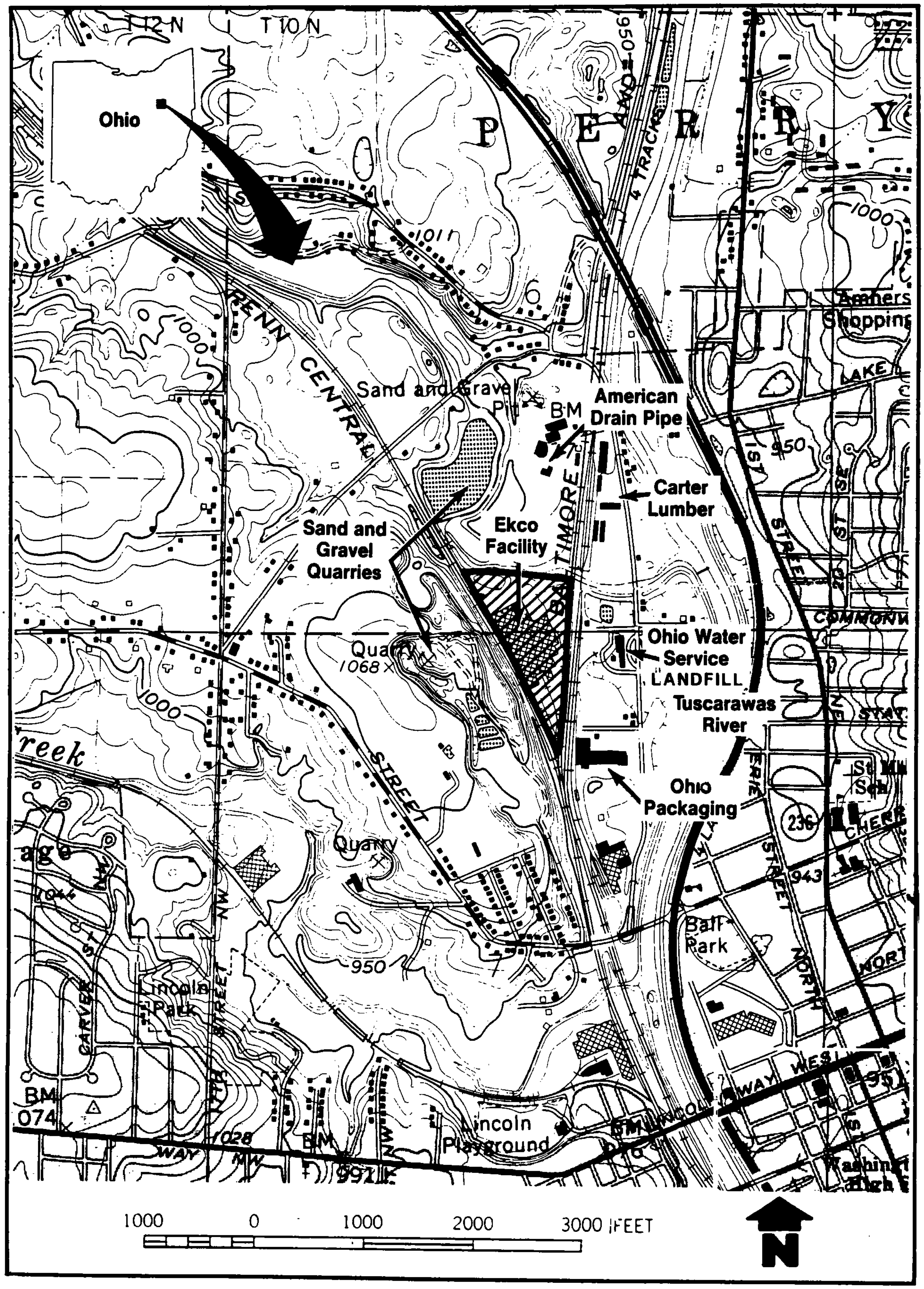

FIGURE 1-1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

boundary adjacent to Newman Creek. Waste waters from manufacturing were discharged to the surface impoundment.

During 1954, the EKCO Housewares facility began electroplating operations. The primary function of these operations was to copper plate cookware manufactured at the facility. Solvents (primarily TCE or 1,1,1-TCA) were used to clean the products prior to plating. However, 1,1,1-TCA and TCE were never used at the same time. Sometime during the mid 1960's, EKCO stopped using TCE; use of TCE was reinitiated in the 1980s. In the period in between, 1,1,1-TCA was used.

By 1967, trends in the cookware manufacturing industry had changed, resulting in the installation of porcelain and teflon coating units at the EKCO facility. In 1969, with the development of new NPDES regulations and permit requirements, the surface impoundment was approved and permitted by the state of Ohio to discharge waste products associated with plant activities (see Appendix H). These waste products have included:

- Deionizers from copper plating operations (hydrochloric acid and sodium hydroxide).
- Washings and waste material from manufacturing porcelain-teflon coated aluminum cookware (aluminum frit, various coloring inorganics oxides, lead, cadmium, selenium, cobalt).
- Alkaline washer fluids to clean aluminum cookware.

In July 1974, NPDES Permit No. C-3094BD was issued to the EKCO Housewares facility (Appendix H). As the 1970's progressed, EKCO discontinued the manufacturing of aluminum and porcelain cookware and use of the lagoon ceased in 1977. By the end of 1978, all copper plating operations had ended and the principal products manufactured at the facility became pressed and coated non-stick bakeware.

Correspondence between EKCO and the Ohio Environmental Protection Agency identified a solvent spill which had occurred between 1979 and 1980 as the only major recorded spill at the facility. The spill was in the vicinity of process water well W-10 (Figure 1-2). Neither the exact location nor the extent of the spill was documented. It should be noted that W-10 is located in a sump and is covered with a grate flush with the plant floor, which makes the well head vulnerable to floor drainage.

The surface impoundment was reactivated in 1980 under the existing NPDES permit and received housing degreaser filter water until mid-1984. The surface impoundment was finally decommissioned in December 1985.

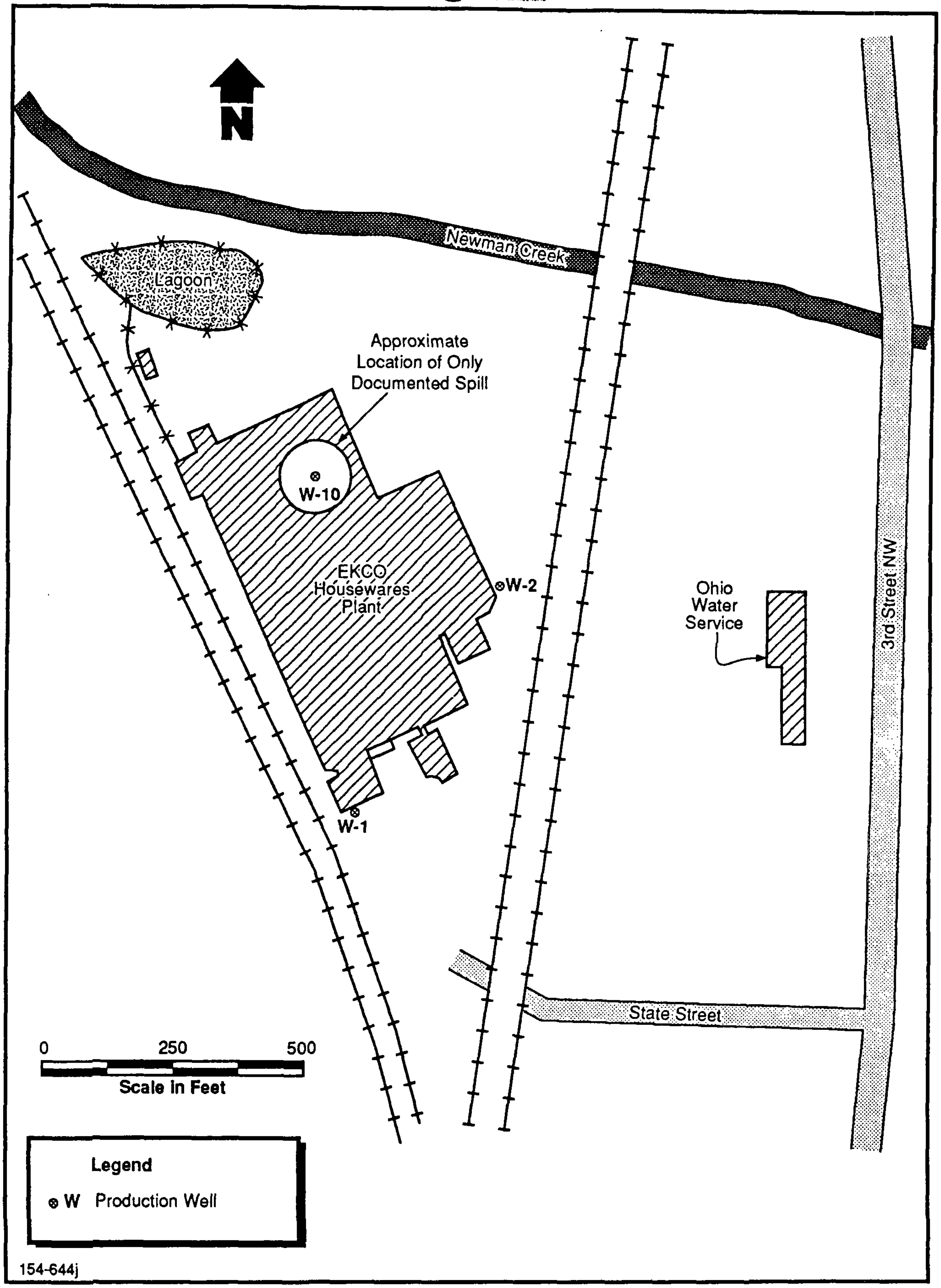

FIGURE 1-2 APPROXIMATE LOCATION OF THE ONLY DOCUMENTED SPILL

In March 1984, when the plant applied for a renewal of their NPDES Permit, analysis of on-site well water for volatile organics was required. The analysis indicated the presence of 1,1,1-TCA and TCE. This discovery resulted in subsequent investigations at EKCO. These investigative activities are described in Section 1.4 of this report.

The waste stream was diverted from the surface impoundment to discharge in Newman Creek in December 1985. The surface impoundment (lagoon) was permanently taken out-of-service. The procedure followed when the lagoon was taken out of service was simply the termination of discharging wastewater into the lagoon. No additional activities or remedial procedures were conducted at the lagoon.

EKCO continues to manufacture pressed and coated non-stick bakeware at the Massillon facility. A silicon-based compound is presently used to coat the bakeware to create the non-stick surface.

1.4 PREVIOUS INVESTIGATIVE ACTIVITIES

In 1984, with the discovery of 1,1,1-TCA and TCE in the groundwater beneath the plant, EKCO initiated a number of activities to investigate the problem. During the months of September and October 1984, seven test holes were drilled by Ohio Drilling, Inc. at the facility. Four test holes (TH-1-84 through TH-4-84) were drilled into the overburden and the remaining three were drilled into bedrock. Soil and water samples were collected from all locations and revealed varying levels of volatile organic compounds (VOCs). Two of the shallow test holes, TH-1-84 and TH-2-84 were completed as 1 1/4-inch I.D. piezometers (P-1-84 and P-2-84, respectively), while the remaining two were plugged. All three of the bedrock test holes were completed as 6-inch (I.D. Casing) bedrock wells (R-1 through R-3) with dedicated pumps. An additional bedrock well (R-4) was installed in July, 1985 along the eastern property boundary. No contaminants were found in samples collected from this well.

Since the then out-of-service production well (W-10) was centrally located on the ECKO property, it was decided that a pump and treat program to utilizing this well would be initiated at the facility to control VOCs. With the concurrence of the Ohio EPA, an air stripper was installed by Ohio Drilling, Inc. in February 1986.

On 17 June 1986, Floyd Brown Associates, Limited (FBA), contracted by ECKO, developed a preliminary closure plan for the lagoon. The closure plan led to the Phase I screening investigation of the lagoon, which involved the performance of 12 soil borings (Figure 1-3). The results indicated apparently elevated levels of cadmium, chromium and lead in soil samples collected within the lagoon and in the downgradient locations (Table 1-1). No VOCs were detected in any of the composited samples.

The Phase I investigation led to a more intensive Phase II soil boring program conducted by FBA in January and February 1987. The program involved performance of 25 additional soil borings (Figure 1-4). Four of these soil borings were completed as 1-1/2-inch (I.D.) PVC wells (D-1-27, D-2-30, D-3-17, D-4-30) and were retained as monitoring points for the lagoon. Results of analyses are presented in Tables 1-2 and 1-3.

In July 1987, Roy F. Weston, Inc. (WESTON) was contracted to begin development of a final closure program for the lagoon and to develop a groundwater quality assessment program for the entire ECKO facility.

In September 1987, WESTON conducted an assessment to collect baseline information and to determine the need for interim corrective measures. This included the following activities:

- Sampling of Ohio Water Service Well No. 4 and all on-site wells (except the out-of-service process water well W-2) to establish baseline data for each well and collecting well data (OVA readings, construction details, depth to water measurements, etc.). The results of the groundwater sampling are presented in Appendix A of this report.

- Surveying all on-site wells.

- Conducting a groundwater utilization survey which included identifying and locating domestic, commercial and municipal wells within a one-mile radius of the site.

- Reviewing plant records and other available documents which included aerial photographs, tax maps and geologic references.

The results of this initial investigation were presented in the Interim Measures Report, February 1988. While no immediate threat to potable water supplies was identified, WESTON recommended that on-site pumpage be increased, if practical, in order to enhance contaminant recovery and hydraulic control of groundwater underlying the plant.

1.5 REGIONAL SETTING

1.5.1 Regional Geology

Most of Stark County, Ohio has been covered by at least two continental ice sheets resulting in variable surficial geologic conditions. The glaciers covered the land surface with a veneer of glacial drift deposits, which range from fine clay par-

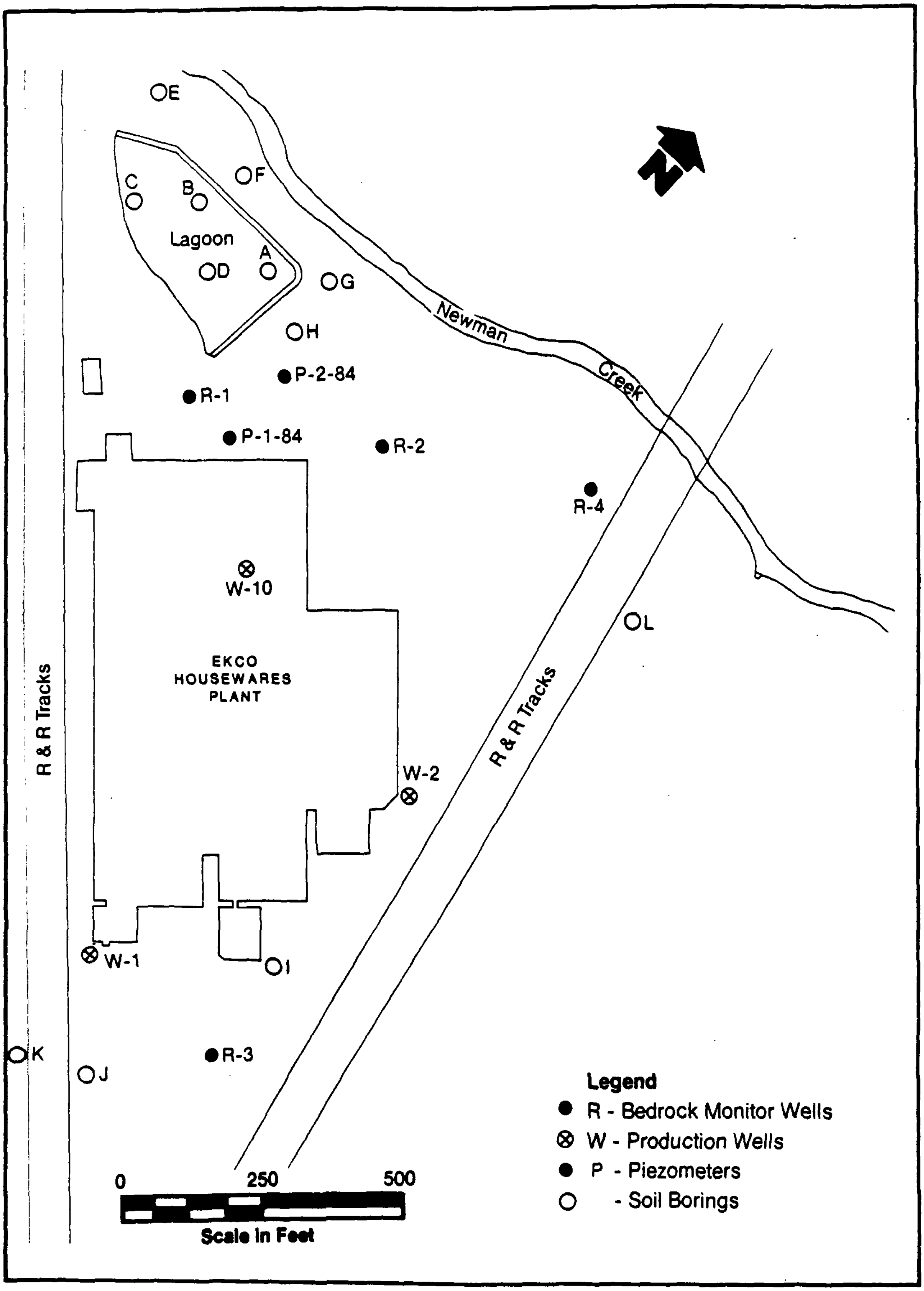

FIGURE 1-3 LOCATIONS OF FLOYD BROWN ASSOCIATES PHASE I SOIL BORINGS EKCO HOUSEWARES, INC., MASSILLON, OHIO

TABLE 1-1

Results of Composited (by depth) Lagoon Soil Boring Samples FBA Phase I Soil Boring Program*

	Lagoon Composite Soils (Stations A through D)+							
Interval	0-1 Ft	1-2 Ft	2-3 Ft	3-4 Ft	6 Ft	8 Ft	10 Ft	12 Ft
Arsenic, mg/kg	13	12	12	21	9	10	11	13
Barium, mg/kg	600	130	77	140	58	42	120	42
Cadmium, mg/kg	450	4	>0.9	1.3	0.7	0.9	27	0.7
Copper, mg/kg	880	400	93	47	20	12	230	15
Lead, mg/kg	2,430	1,670	12	17	18	8	190	13
Nickel, mg/kg	55	28	12	29	23	23	23	38
Selenium, mg/kg	3	>3	>4	>5	>3	>2.4	>4	>3
Zinc, mg/kg	830	1,370	70	500	120	170	200	73
Cyanide, mg/kg	0.3	0.4	0.6	1.6	0.4	0.2	0.2	0.2

* Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 4 November 1986.

+ Locations found on Figure 1-3.

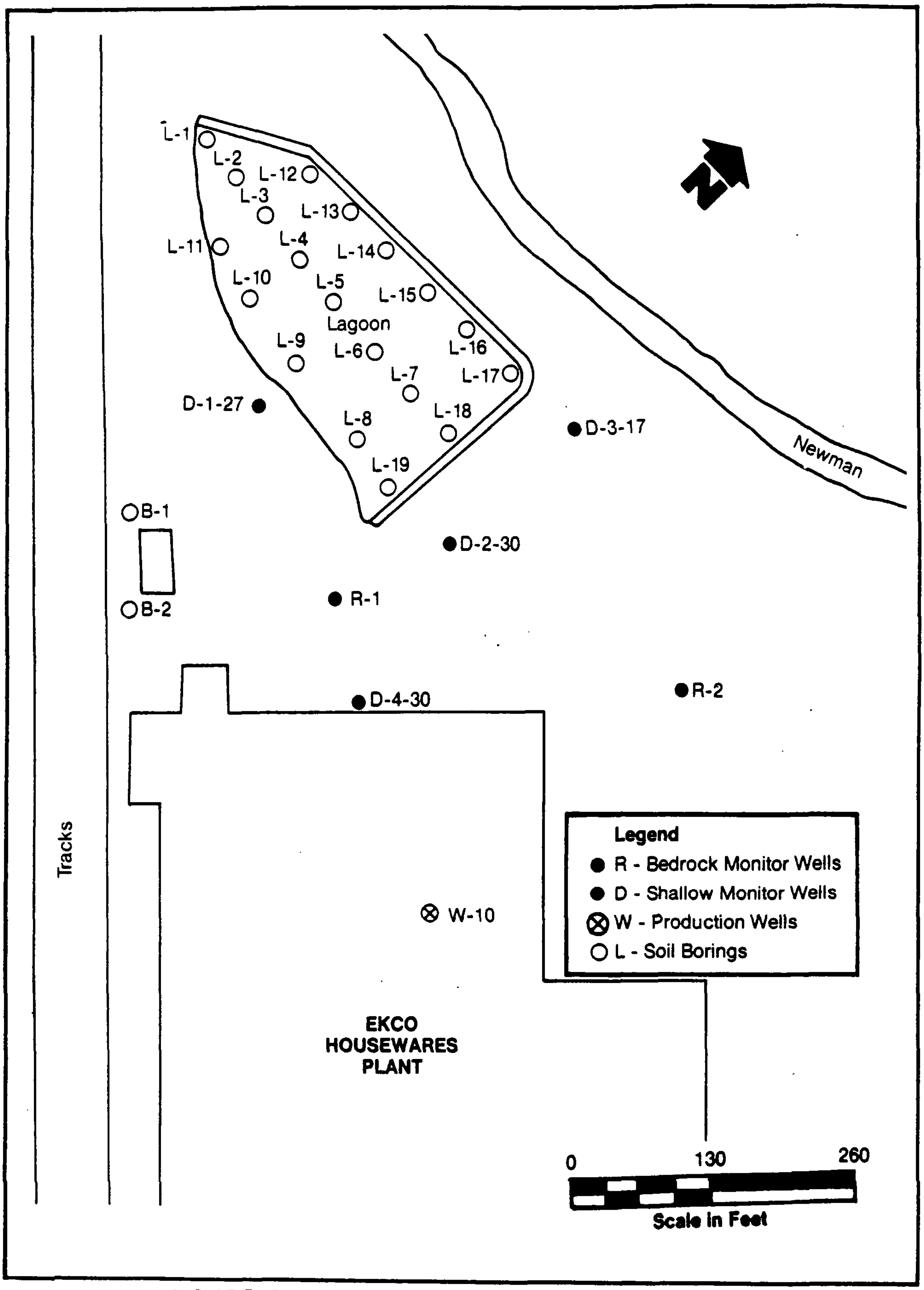

FIGURE 1-4 LOCATIONS OF FLOYD BROWN ASSOCIATES PHASE II SOIL BORINGS EKCO HOUSEWARES, INC., MASSILLON, OHIO

Table 1-2

Results of Cadmium, Chromium and Lead Analyses in 153 Soil Samples

Soil Loc.	Total Solid	Cadmium mg/kg	Chrimium mg/kg	Lead mg/kg
L-1-1	71	20	45	170
L-1-2	76.8	2	6	360
L-1-3	76.4	1	19	980
L-1-4	75.3	0.5	4	30
L-1-5	58.1	20	16	170
L-1-6	73	0.4	<0.80	11
L-1-7	80	2	3	30
L-1-8	66.1	0.5	<0.90	9
L-1-9	86	(0.30	(0.60	10
L-1-10	94	0.47	(0.90	7
L-2-1	63.9	180	130	940
L-2-2	74.4	2	10	400
L-2-3	73.1	>0.60	4	20
L-2-4	80.5	0.4	4	13
L-2-5	75.7	0.5	4	11
L-2-6	73.3	0.5	4	8
L-2-7	81.5	0.4	5	15
L-2-8	84.5	>0.50	2	8
L-2-9	88	0.5	2	5
L-2-10	88.6	>0.40	6	13
L-3-1	69.6	360	230	1200
L-3-2	80.6	>0.50	3	6
L-3-3	81.7	>0.50	4	6
L-3-4	83.9	0.5	2	3
L-3-5	85.7	0.4	2	4
L-3-6	87.6	>0.40	2	8
L-3-7	89.8	>0.40	1	10
L-3-8	85.4	>0.30	2	>1
L-4-1	40.7	1700	790	2800
L-4-2	75.4	0.6	6	13
L-4-3	77.6	0.8	6	8
L-4-4	77.3	>0.50	9	6
L-4-5	71.6	180	70	500
L-4-6	79	>0.30	5	6
L-4-7	74.9	0.4	6	12
L-4-8	87.8	>0.50	3	7
L-4-9	82	>0.20	2	3
L-4-10	85.3	>0.30	2	4
L-4-11	84.3	>0.40	5	3
L-5-1	51.4	1100	500	2400

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

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Table 1-2
(continued)

Soil Loc.	Total Solid	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg
L-5-2	79.8	2	8	70
L-5-3	72.9	58	12	230
L-5-4	73	0.5	6	19
L-5-5	56.4	2	8	27
L-5-6	50.2	1	13	50
L-5-7	48.4	80	50	380
L-5-8	90.9	1	5	30
L-5-9	91.2	0.5	4	15
L-5-10	87.3	1	3	17
L-5-11	88.7	1	3	13
L-6-1	80.3	660	120	1700
L-6-2	66.3	4	7	55
L-6-3	66.5	10	20	80
L-6-4	50	2	18	60
L-6-5	74.3	3	11	50
L-6-6	91.9	1	4	30
L-6-7	90	4	4	30
L-6-8	97	0.5	3	8
L-6-9	88.9	0.4	2	5
L-6-10	86.2	0.5	2	10
L-7-1	69.5	600	290	2800
L-7-2	81.7	1	60	560
L-7-3	71.7	3	110	20
L-7-4	71.7	50	80	430
L-7-5	81	1	1	9
L-7-6	73.6	4	10	40
L-7-7	78.9	10	20	110
L-7-8	81.7	23	40	250
L-7-9	88.2	1	3	10
L-7-10	89.4	0.4	>1	6
L-7-11	90.5	1	4	9
L-7-12	91.3	0.5	>1	6
L-8-1	68.5	30	290	1400
L-8-2	65.9	7	60	85
L-8-3	63.7	2	130	40
L-8-4	72.6	3	90	180
L-8-5	74.7	2	40	40
L-8-6	67.1	2	6	60

Table 1-2
(continued)

Soil Loc.	Total Solid	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg
L-8-7	89.4	1	2	20
L-8-8	59.9	1	>1	12
L-8-9	66.2	>1	3	7
L-8-10	86.2	1	3	7
L-8A	26.9	8400	510	13800
L-9-1	75.4	12	170	940
L-9-2	75.3	4	2	20
L-9-3	74.3	2	6	14
L-9-4	63	3	3	20
L-9-5	51.2	4	2	20
L-9-6	40.7	8	4	25
L-9-8	91.2	>0.5	2	3
L-9-9	90.8	>0.5	2	6
L-9-10	86.6	>0.5	2	2
L-9-11	88.2	2	3	7
L-9-12	88.4	0.4	3	6
L-10-1	71.9	90	80	740
L-10-2	80	4	9	780
L-10-3	69	4	1200	70
L-10-4	71.1	<0.7	8	5
L-10-5	78.7	0.8	5	130
L-10-6	88.5	2	5	30
L-10-7	91.1	0.5	3	4
L-10-8	85.8	<0.5	2	2
L-10-9	90.4	0.4	5	6
L-10-10	87.9	0.8	5	6
L-10-11	83.4	0.5	5	3
L-11-1	56.9	300	280	1100
L-11-2	76	1	26	30
L-11-3	77	0.6	52	20
L-11-4	80.7	0.6	7	4
L-11-5	85.7	<0.5	2	2
L-11-6	83.8	0.4	3	64
L-11-7	88.6	<0.5	4	7
L-11-8	88.9	0.5	3	6
L-11-9	85	0.6	3	7

Table 1-2
(continued)

Soil Loc.	Total Solid	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg
B-1-1	88.1	2	6	20
B-1-2	86.6	0.5	5	18
B-1-3	87	1	6	67
B-1-4	84	0.6	3	5
B-1-5	84.1	0.6	3	27
B-1-6	88.3	0.6	3	4
B-1-7	89.6	0.5	5	8
B-1-8	88.9	0.5	8	5
B-1-9	91	0.6	9	6
B-1-10	93.9	0.5	8	5
B-2-1	85.5	4	25	600
B-2-2	88.4	0.5	6	32
B-2-3	81.8	0.6	13	21
B-2-4	87.6	0.6	6	24
B-2-5	88	0.5	8	3
D-1-1	83.4	33	300	200
D-1-2	82.7	0.5	5	11
D-1-3	80.7	0.5	8	11
D-1-4	77.9	1	13	13
D-1-5	85.6	0.5	5	19
D-1-6	80.4	0.6	8	33
D-1-7	73.4	0.7	9	26
D-2-1	85.5	110	92	490
D-2-2	79.9	1600	340	4740
D-2-3	81.7	1300	210	2950
D-2-4	84.9	93	130	190
D-2-5	80.5	830	180	1570
D-2-6	90	1	24	400
D-2-7	82.2	0.5	22	290
D-2-8	80.7	0.8	7	420
D-2-9	76.8	1	34	480
D-2-10	76	0.6	9	80
D-2-11	79.2	0.6	6	10
D-2-12	79.7	0.5	5	8
D-3-1	86.5	0.6	6	16
D-3-2	89.5	0.5	5	13
D-3-3	89.4	0.6	7	13
D-3-4	81.5	0.6	5	5

Table 1-3

RESULTS OF VOLATILE ORGANIC ANALYSES IN D-2-30 and D-4-30

FBA - Ekco
Priority Pollutant Volatile Fraction

	0-1'	1'-2'	2'-3'	3'-4'
ATEC SAMPLE NO.	10132	10133	10134	10135
CLIENT SAMPLE NO.	D-2-1	D-2-2	D-2-3	D-2-4
DATE RECEIVED	01/21/87	01/21/87	01/21/87	01/21/87
Acrolein	<1.0	<1.0	<1.0	<1.0
Acrylonitrile	<1.0	<1.0	<1.0	<1.0
Benzene	<0.3	<0.03	<0.03	<0.03
Bromoform	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07	<0.07	<-.07
Chlorobenzene	<0.03	<0.03	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Chloroethane	<1.01	<1.0	<1.0	<1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07	<0.07	<0.07
Chloroform	<0.07	<0.07	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Dichlorodifluoromethane	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03	<0.03	<0.03
Methyl Bromide	<1.0	<1.0	<1.0	<1.0
Methyl Chloride	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03	<0.03	<0.03
Toluene	<0.03	<0.03	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,1,1-Trichloroethane	<0.07	<0.07	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07	<0.07	<0.07
Trichloroethene	0.04	0.07	0.11	0.15
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50
Vinyl Chloride	<1.0	<1.0	<1.0	<1.0
Total Xylenes	<0.03	<0.03	<0.03	<0.03

All results are reported as mg/kg

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

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WESTON

Table 1-3
(continued)

FBA - Ekco
Priority Pollutant Volatile Fraction

	8-10'	13'-14'
ATEC SAMPLE NO.	10138	10141
CLIENT SAMPLE NO.	D-2-7	D-2-10
DATE RECEIVED	01/21/87	01/21/87
Acrolein	<1.0	<1.0
Acrylonitrile	<1.0	<1.0
Benzene	<0.3	<0.03
Bromoform	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07
Chlorobenzene	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07
Chloroethane	<1.0	<1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07
Chloroform	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07
Dichlorodifluoromethane	<1.0	<1.0
1,1-Dichloroethane	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03
Methyl Bromide	<1.0	<1.0
Methyl Chloride	<1.0	<1.0
Methylene Chloride	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03
Toluene	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07
1,1,1-Trichloroethane	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07
Trichloroethene	0.39	0.06
Trichlorofluoromethane	<0.50	<0.50
Vinyl Chloride	<1.0	<1.0
Total Xylenes	<0.03	<0.03

All results are reported as mg/kg

6277B

Table 1-3
(continued)

FBA - Ekco
Priority Pollutant Volatile Fraction
SW-846 Method 8240

	0.75-1.5	3.0-4.5	7.5-9.0	11.75-12.5
ATEC SAMPLE NO.	10364	10365	10366	10367
CLIENT SAMPLE NO.	D-4-2	D-4-5	D-4-8	D-4-12
DATE RECEIVED	02/18/87	02/18/87	02/18/87	02/18/87
Acrolein	<1.0	<1.0	<1.0	<1.0
Acrylonitrile	<1.0	<1.0	<1.0	<1.0
Benzene	<0.3	<0.03	<0.03	<0.03
Bromoform	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07	<0.07	<0.07
Chlorobenzene	<0.03	<0.03	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Chloroethane	<1.0	<1.0	<1.0	<1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07	<0.07	<0.07
Chloroform	<0.07	<0.07	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Dichlorodifluoromethane	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03	<0.03	<0.03
Methyl Bromide	<1.0	<1.0	<1.0	<1.0
Methyl Chloride	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03	<0.03	<0.03
Toluene	<0.03	<0.03	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,1,1-Trichloroethane	2.26	<0.07	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07	<0.07	<0.07
Trichloroethene	5.30	0.26	1.48	0.08
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50
Vinyl Chloride	<1.0	<1.0	<1.0	<1.0
Total Xylenes	<0.03	<0.03	<0.03	<0.03

All results are reported as mg/kg

Table 1-3
(continued)

FBA - Ekco
Priority Pollutant Volatile Fraction
SW-846 Method 8240

	15.5-17.0	19.25-20.0
ATEC SAMPLE NO.	13068	13069
CLIENT SAMPLE NO.	D-4-15	D-4-19
DATE RECEIVED	02/18/87	02/18/87
Acrolein	<1.0	<1.0
Acrylonitrile	<1.0	<1.0
Benzene	<0.3	<0.03
Bromoform	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07
Chlorobenzene	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07
Chloroethane	<1.0	<1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07
Chloroform	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07
Dichlorodifluoromethane	<1.0	<1.0
1,1-Dichloroethane	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03
Methyl Bromide	<1.0	<1.0
Methyl Chloride	<1.0	<1.0
Methylene Chloride	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03
Toluene	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07
1,1,1-Trichloroethane	<0.16	<0.07
1,1,2-Trichloroethane	<0.07	<0.07
Trichloroethene	1.27	0.03
Trichlorofluoromethane	<0.50	<0.50
Vinyl Chloride	<1.0	<1.0
Total Xylenes	<0.03	<0.03

All results are reported as mg/kg

ticles to boulders. The glacial drift thickness ranges from less than 25 feet to about 100 feet. In the areas of buried valleys, this unconsolidated material can exceed 500 feet in thickness (Ohio Department of Natural Resources, 1972).

Melting ice from the receeding glaciers produced large quantities of water carrying outwash material. This outwash material, deposited in broadly spread outwash plains and in restricted valleys in the form of kames, eskers and valley fill, is generally composed of well sorted, cross-bedded and horizontally layered sands and gravels.

Underlying the glacial drift and outwash deposits are sedimentary rocks of the Pennsylvanian, Mississippian, and Devonian geologic systems. These bedrock formations dip generally to the southeast at about 20 to 40-feet per mile and consist of sandstone and shale with some interbedded coal and occasional thin limestone units (Cross and Hedges, 1959). Table 1-4 summarizes the generalized stratigraphic sequence for northeast Ohio. Figure 1-5 presents the regional surface geology, including a cross section, of Ohio.

1.5.2 Regional Hydrogeology

The western portion of Stark County lies within the Middle Tuscarawas River Basin. The units capable of providing sufficient quantities of groundwater to domestic, commercial and municipal wells underlying this basin include the unconsolidated deposits of sand and gravel and the consolidated layers of sandstone, shale, limestone and coal. Yields may range from less than 1 gallon per minute (gpm) from clay and shale deposits to more than 1,000 gpm from thick, permeable sand and gravel deposits (Schmidt, 1962). The generalized stratigraphic table (Table 1-4) briefly describes the physical and water-producing characteristics of the units within the Tuscarawas River Basin. Figure 1-6 illustrates the availability and yield of groundwater in the western portion of Stark County.

The outwash deposits beneath the flood plain of the Tuscarawas River have the greatest potential for the development of large groundwater supplies in this basin. Yields from properly developed wells in this unit range from 500 to more than 3,000 gpm. The majority of these wells are developed at depths less than 160 feet (Schmidt, 1962).

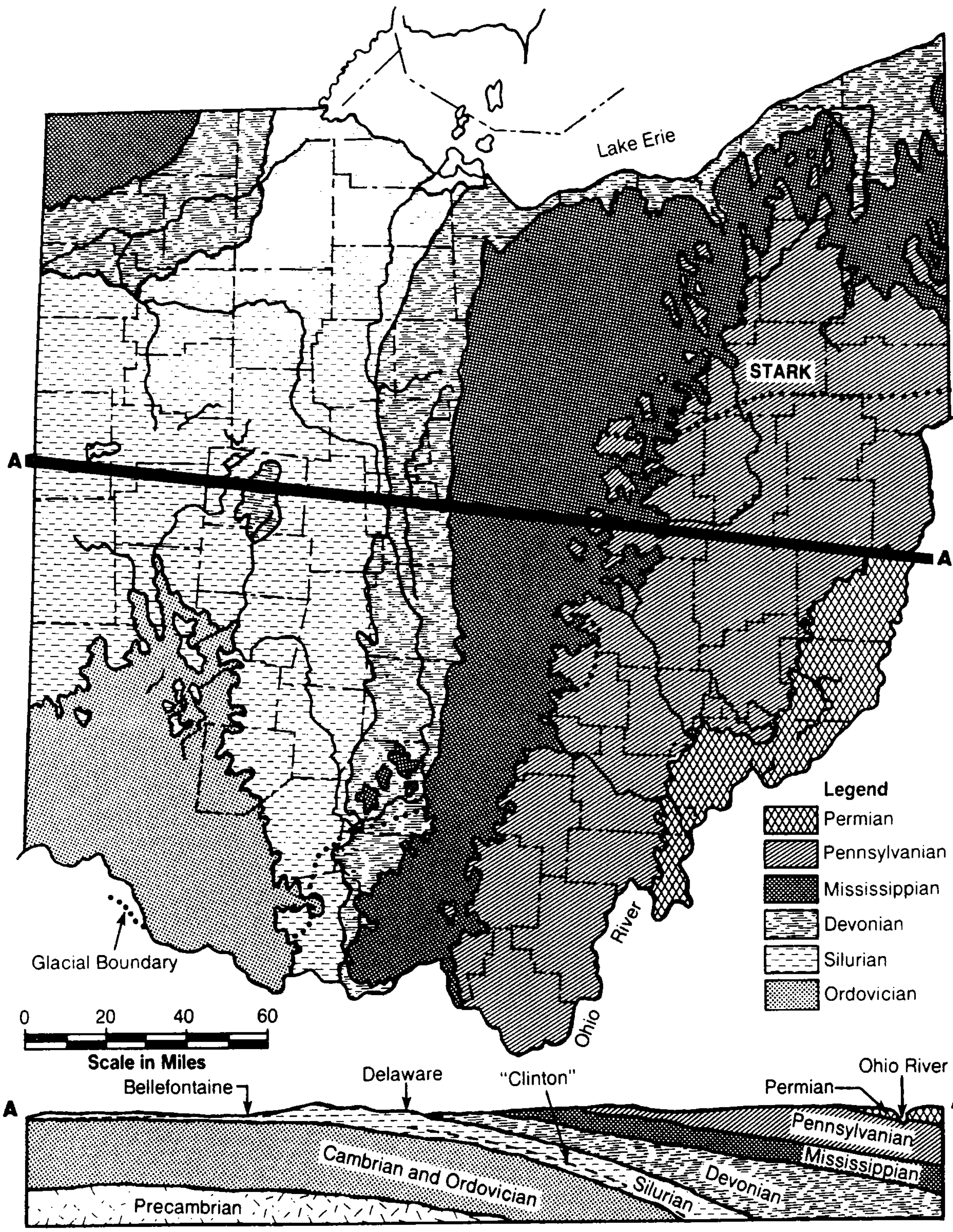
Many of the tributaries to the Tuscarawas River are also underlain by thick outwash deposits composed of predominantly clay interbedded with layers of fine sand and gravel. Portions of these tributary valleys are filled with as much as 270 feet of unconsolidated deposits (Schmidt, 1962). But, because of the predominance of clay, the average yield of these deposits is less than 25 gpm, and, water wells are typically drilled through these unconsolidated deposits to the underlying bedrock.

Table 1-4

Generalized Stratigraphic Sequence in Middle Tuscarawas River Basin

System or Series	Group or Formation	Character of Material	Water-Bearing Characteristics
Quaternary		Clay, silt and alluvium deposited on the flood plains of the principal valleys.	Generally a poor source of groundwater, owing to limited thickness and absence of coarse materials.
Quaternary Pleistocene		Interbedded and interlensing layers of sand, gravel, and clay deposited in the buried valleys by glacial meltwaters.	Quantity of underground water available depends on character of material and source of recharge. Properly developed wells yield in excess of 1,000 gpm.
		Thick layers of silt and clay interbedded with relatively thin lenses of sand and gravel.	Drilled wells developed in the sand and gravel yield 5 to 15 gpm.
Pennsylvanian	Pottsville	Alternating layers of shale, sandstone, limestone, and coal.	Yields sufficient underground water for farm and domestic needs.
		Thin to thick, coarse-grained sandstone.	Domestic, farm and industrial supplies are readiy available. Yields of as much as 500 gpm reported. However, regional yield seldom exceeds 15 gpm.
Mississippian		Alternating layers of sandstone and shale.	Farm and domestic supplies are readily developed. If thick shale formations predominate, meager groundwater supplies are developed.

SOURCE: (Schmidt, 1962)



(Source: Division of Geological Survey
Ohio Department of Natural Resources)

FIGURE 1-5 GEOLOGIC MAP AND CROSS SECTION OF NORTHEAST OHIO

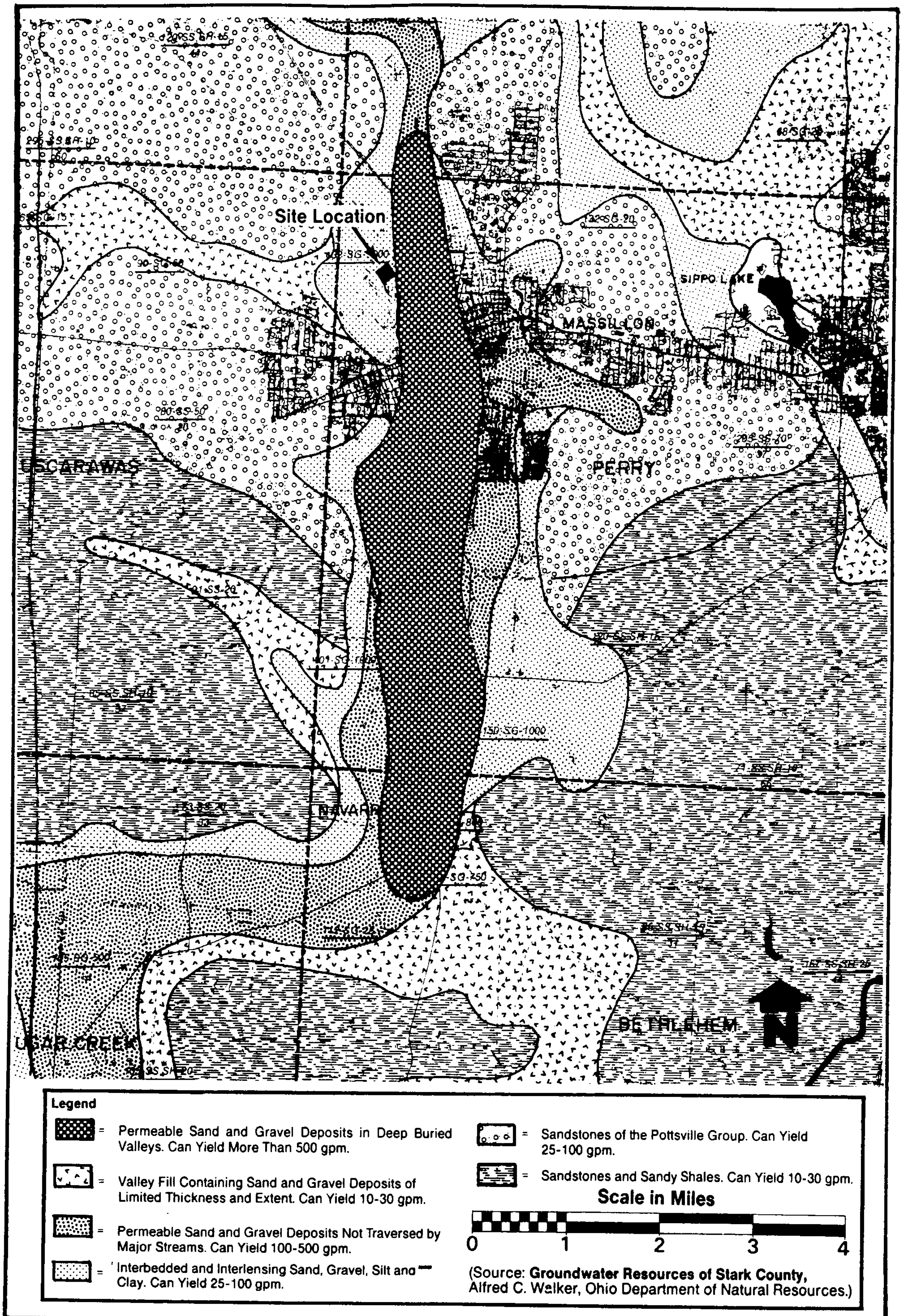


FIGURE 1-6 GROUNDWATER RESOURCES OF MASSILLON, OHIO

The bedrock underlying the glacial deposits in the basin consists of interbedded, thin to thick layers of sandstone, shale, coal and occasional limestone. All of these are part of the Pottsville Group of Pennsylvanian age. Due to the vertical variations in lithology and hence permeability within the Pottsville Formation in the area, groundwater wells reportedly range in depth from 46 feet to 500 feet. It has been reported that yields of groundwater range from less than one to more than 500 gpm (Schmidt, 1962). The average domestic well is 170 feet in depth and yields about eight gpm. Yields of commercial and municipal wells developed in the sandstone units of the lower Pottsville Formation are reported to range from 25 to 100 gpm (Walker, 1979).

1.5.3 Local Groundwater Use

1.5.3.1 Ohio Water Service Wells

Currently, Ohio Water Service Co. (OWS) has seven active production wells (OWS-1, 2, 3, 5, 7, 8, 9), and one well (OWS-4) which was abandoned and converted into an observation well. OWS-4 was abandoned due to the detection of vinyl chloride at a concentration above the drinking water standard in a sample from the well. OWS-1, 2, and 3 are located approximately 2,000 feet northeast of the facility and 150 to 200 feet east of the Tuscarawas River (Figure 1-7). OWS-5 is located approximately 4,200 feet north of the facility and 100 feet west of the Tuscarawas River. OWS-7, 8, and 9 all lie approximately 1.6 miles north of the facility and are approximately 100 feet west of the Tuscarawas River. The abandoned well, OWS-4, is currently being used as a monitoring well and is located 1,000 feet east of the facility and approximately 500 feet west of the Tuscarawas River.

The OWS well field pumps approximately 7.5 million gallons per day (gpd) from the production wells. Individual wells are pumped at varying rates to maintain this production. Only three wells are normally run at any one time. When running, the rates at which OWS-1, 2, 3, 5, 7, 8, and 9 are pumped are approximately 2,800, 1,260, 350, 2,450, 2,100, 2,100, and 2,000 gpm, respectively. OWS-1 failed in March 1985 and was not put back into service until December 1986. All of the OWS wells are reported to have been constructed with 50 foot screens and reach total depths of 150 to 160 feet, with the exception of OWS-5, which has a reported total depth of 130.5 feet. All OWS wells are reportedly screened in the unconsolidated material, which lies on top of the bedrock.

1.5.3.2 EKCO Recovery Wells

There are currently two on-site production wells (W-1 and W-10) being used as recovery wells. W-1 is located near the southern corner of the building, and W-10 is about 800 feet north of W-1 and is located inside the building (Figure 1-8).

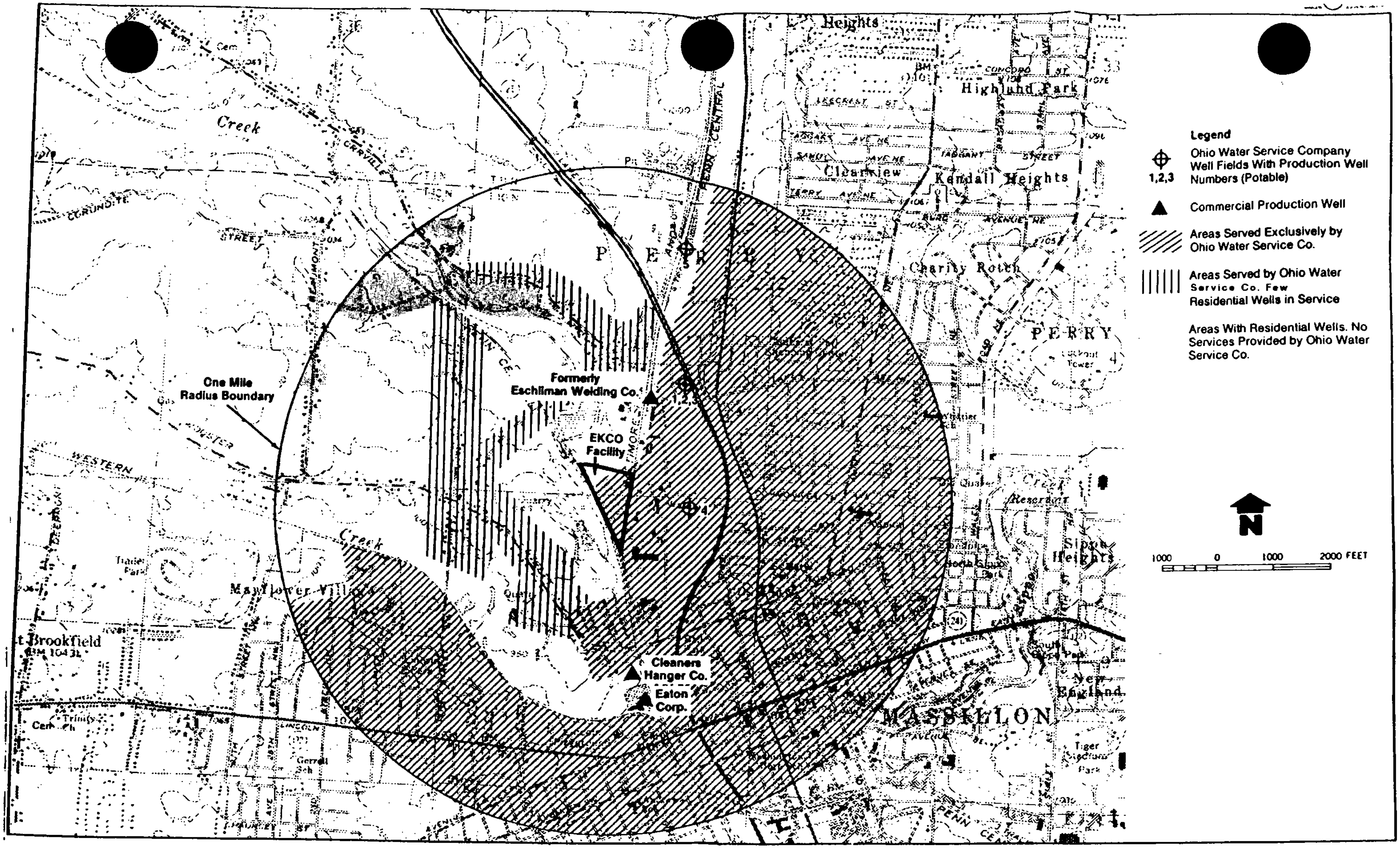


FIGURE 1-7 **WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY**

(Ref 7.5 Minute Massillon Quad, Ohio, 1978)

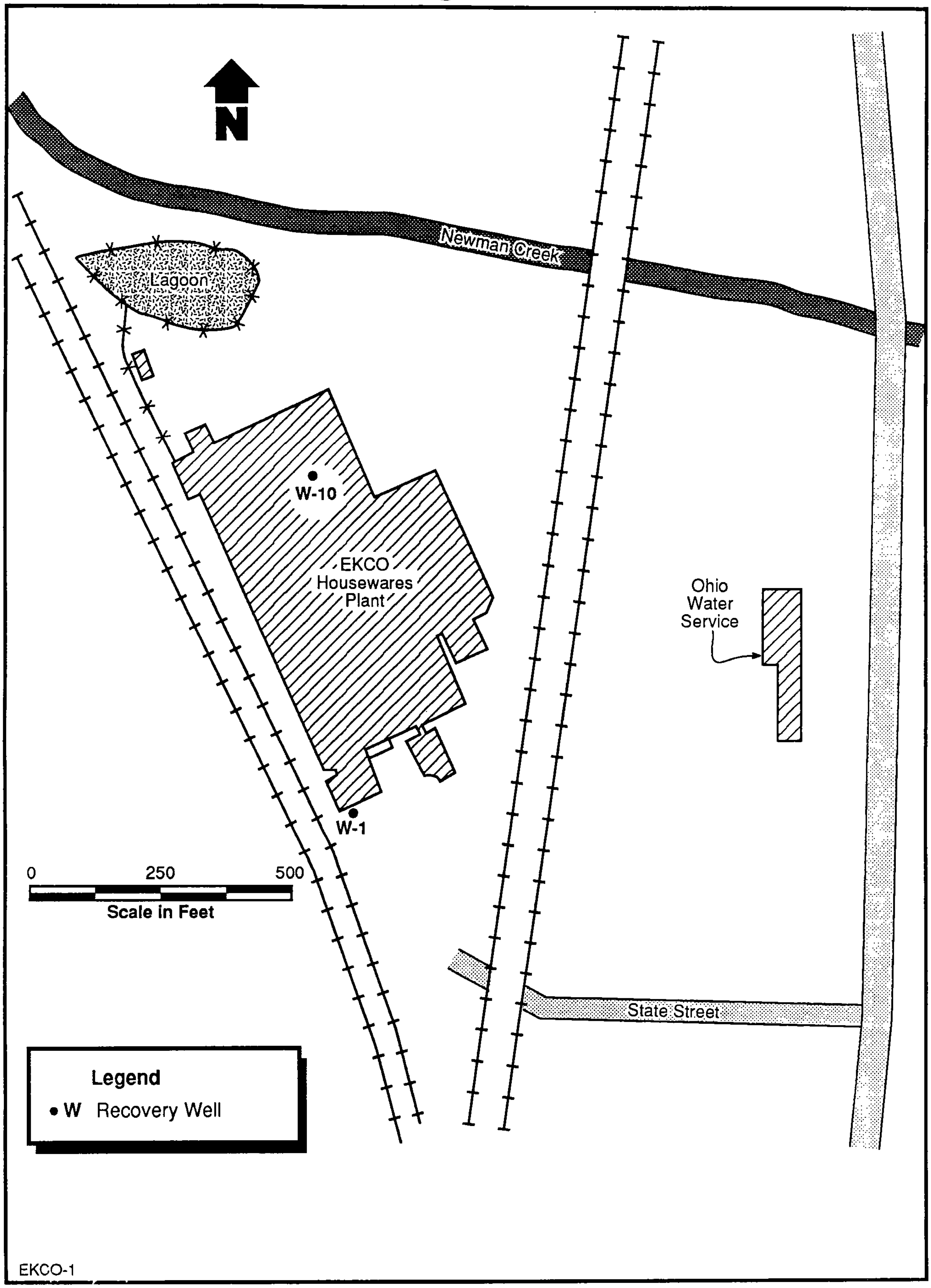


FIGURE 1-8 EKCO FACILITY RECOVERY WELLS

W-1 is completed as an open hole well in bedrock to a total depth of 225 feet. Shale was encountered at 25 feet, followed by a series of interbedded sandstones and shales. The log for W-1 (Appendix C) shows a total of approximately 116 feet of shale interbedded with 84 feet of sandstone. Thickness of sandstone beds reported in the log vary from a minimum of 12 to a maximum of 49 feet. Shales vary from 13 to 46 feet in thickness. Construction details for W-10 are unavailable at this time, but it is believed to be cased to bedrock (approximately 60 feet) and completed as an open hole well in bedrock to a similar total depth to that of W-1.

The pump and treat recovery system was begun in February 1986 with the concurrence of OEPA. When the system was instituted, W-1 pumped 240 gpm and W-10 pumped 140 gpm. Available records indicate that these pumping rates were fairly constant through the first two years of the pump and treat program. During this time, flow rates reportedly varied about 10 to 15 gpm. In April 1988, the pumping rate of W-10 was increased to 255 gpm, while the rate of W-1 remained fairly constant at 245 gpm. Records indicate that W-10's pumping rate was increased to 305 gpm in May, 330 gpm in August, and 375 in September. The rate of W-1 remained constant at 245 gpm. In December 1988, W-10's rate was 345 gpm and W-1's was 245 gpm.

SECTION 2

FIELD INVESTIGATION ACTIVITIES

2.1 INTRODUCTION

During August and September of 1987, WESTON conducted Phase I (Interim Measures) field activities at the EKCO site. The purpose of these activities was to address immediate concerns expressed by the U.S. EPA, Region V, relating to potential impacts of contaminants in groundwater on area water supplies.

The data gathered during Phase I was used as a basis for design of the Phase II field activities described below. The purpose of these activities was to address groundwater conditions at the EKCO plant. These activities were conducted at EKCO during May through December, 1988. Field activities included:

- Monitoring well installation.
- Surveying.
- Soil gas sampling.
- Soil boring sampling.
- Groundwater, surface water, and sediment sampling.
- Aquifer testing.

Additionally, laboratory analyses of soil, water, and sediment samples were conducted in accordance with the Groundwater Quality Assessment Plan (March 1988). Data collected during the field investigation have been used to produce a groundwater flow model (Section 4) and to evaluate site geologic and hydrogeologic conditions and soil, water, and sediment quality conditions (Section 3).

Details regarding procedures followed in the field are presented in Appendices B and C.

2.2 MONITORING WELL INSTALLATION

During the months of May, June, and July 1988, 16 monitoring wells were installed at the site. One additional well, I-3, was attempted but not installed as no groundwater was encountered. The 16 wells included one bedrock well (R-5), six interface wells (I-2, I-4, I-5, I-6, I-7, I-8), three piezometers (P-3, P-4, P-5), five lagoon wells (L-1 through L-5), and one shallow well (S-7). The locations of the wells are shown on Figure 2-1.

WESTON

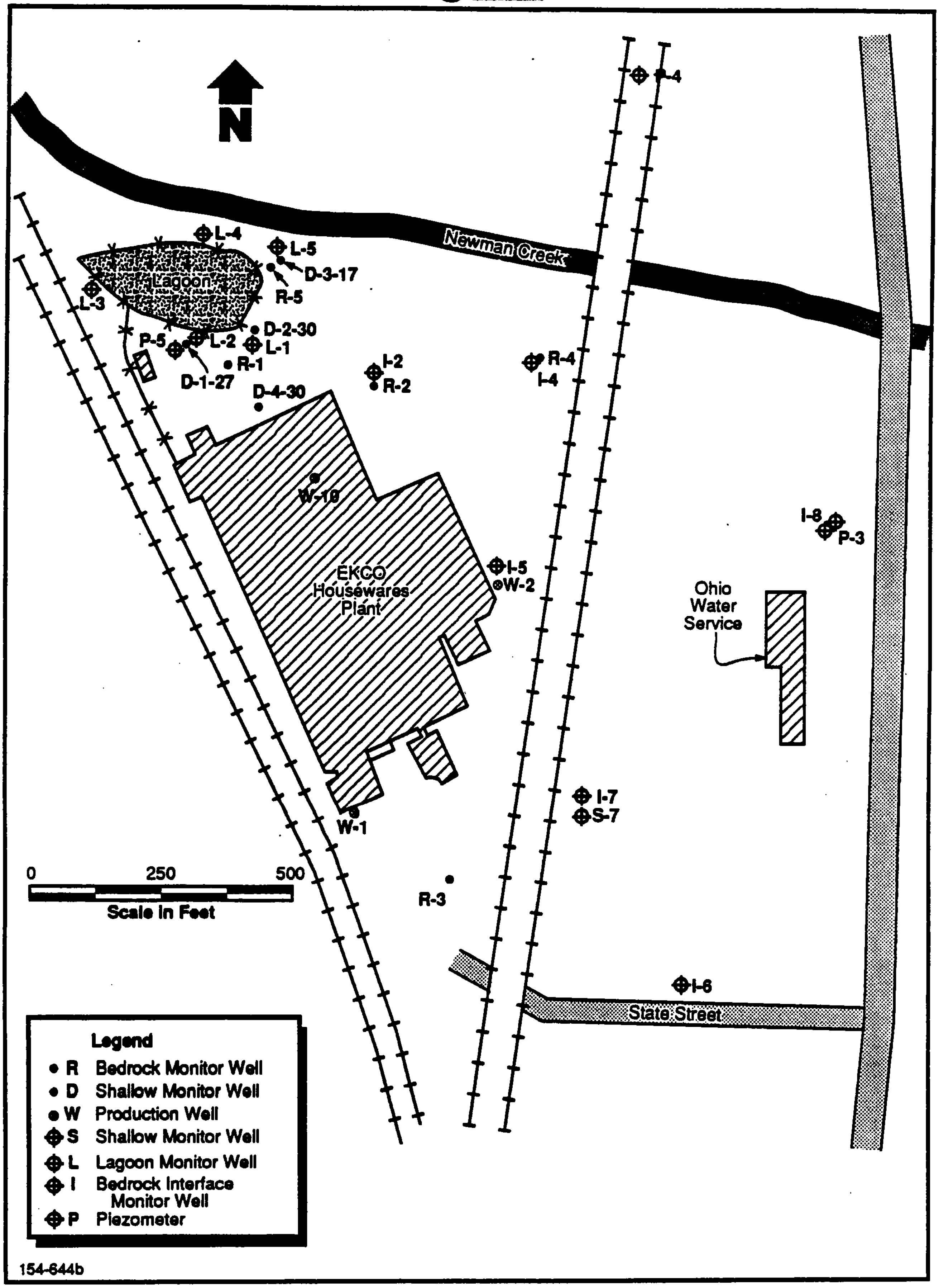


FIGURE 2-1 WELL LOCATION MAP FOR EKCO HOUSEWARES FACILITY

The bedrock well (R-5) was drilled north of the plant and east of the lagoon. This well was installed to evaluate groundwater quality in the bedrock downgradient from the north end of the facility.

The six interface wells were installed with the bottoms of the screened intervals at the bedrock-glacial outwash interface. These wells were installed to evaluate hydraulics and groundwater quality along the base of the unconsolidated deposits. Two of the interface wells (I-2, I-4) are located adjacent to two bedrock wells (R-2, R-4) and are also used for evaluating the vertical gradient between the lower part of the unconsolidated aquifer and the bedrock aquifer.

Three piezometers (P-3, P-4, P-5) were installed in the unconsolidated aquifer to evaluate groundwater flow. Two of the piezometers (P-3, P-4) were installed to evaluate off-site groundwater flow to the east (P-3) and northeast (P-4) of the plant. An additional piezometer (P-5) was installed to evaluate groundwater flow downgradient from the lagoon at the base of the unconsolidated zone.

The five lagoon wells were installed to evaluate the hydraulic conditions around the lagoon. They were installed very close to the lagoon perimeter to provide reliable data for RCRA compliance. Four wells (L-1, L-2, L-4, and L-5) were installed around the lagoon to evaluate groundwater flow and groundwater quality in the assumed downgradient direction, toward Newman Creek and the Tuscarawas River. A fifth lagoon well (L-3) was located upgradient of the lagoon to evaluate background water quality. The new lagoon wells serve as replacements for the previously existing D-wells. The D-wells were not considered to be adequate long term compliance monitoring points because of their small inner diameter and poor development (each well contained large amounts of sediment). However, because of its strategic location, D-4-30 has been retained as a monitoring point during the groundwater assessment.

One additional shallow well (S-7) was installed adjacent to I-7. This well pair is used to evaluate the vertical gradient between shallower and deeper parts of the unconsolidated aquifer as well as groundwater quality at this location.

2.3 SURVEYING

In July 1986 a vertical survey was done by Floyd Brown Associates (FBA). At this time, elevations of four wells were measured. Elevations were obtained using an engineers level. A 2,500 foot traverse was initiated from a known elevation (a manhole north of the plant) and tied back into that known elevation following the traverse, with a reported error of 0.07 feet.

In August 1988, WESTON subcontracted Buckeye Surveying Services, Inc. to do a complete survey determining horizontal and vertical locations of all 29 wells (observation and production) and locating major physical structures (i.e., buildings) on the site. All north and east coordinates were measured from a USGS benchmark on 3rd Street near Ohio Water Service facility (see Figure 2-1).

The vertical measurements were measured from the top of inner casing (TIC), top of outer casing (TOC), and from ground level. As a result of the surveying, Buckeye Inc. provided a base map with a coordinate grid system. This base map was used for large scale mapping. The grid system was used in modeling and is shown on the calibration and simulation maps in Section 4 (Figures 4-1 through 4-15). Results are discussed in Section 3.

2.4 SOIL GAS

The soil gas sampling program was designed to identify potential areas of elevated target VOCs in the shallow soils and to evaluate the potential source areas of these VOCs at the site. The sampling was performed at 50-foot intervals along the foundation of the facility and in suspected source areas, and was expanded outward from the building where elevated levels were detected. Seventy-five samples were collected between 25 October and 2 November 1988. The specific soil-gas sampling protocol is provided in Appendix B. Results are discussed in Section 3.

2.5 SOIL BORINGS AND SOIL SAMPLING

In order to further define the vertical extent and to quantify the levels of VOCs in soils, soil samples were collected from soil borings in areas where elevated VOCs were indicated by the soil gas survey. Soil boring activities were performed between 14 November and 17 November 1988. Fourteen soil borings were completed to the top of the water table. Soil samples were collected every two feet starting at two feet below the ground surface. Samples were analyzed for VOCs, metals, cyanides, and percent moisture. The soil sampling protocol is presented in Appendix B. Results are discussed in Section 3.

2.6 WATER AND SEDIMENT SAMPLING

2.6.1 Groundwater Sampling

During November 1988, groundwater samples were collected from 21 wells on and adjacent to the EKCO site. All the samples were analyzed for VOCs, metals, and cyanides. These wells included:

- 2 EKCO production wells.
- 5 bedrock wells.
- 6 interface wells.

- 5 lagoon wells.
- 2 shallow wells.
- Ohio Water Service Well No. 4.

The analytical results from these wells were used to: characterize the groundwater contaminants, evaluate contaminant migration and to assess the contaminant plume. The number of samples taken, analytical methods used, and sampling protocols are outlined in Appendix B. Results are discussed in Section 3.

2.6.2 Surface Water Sampling

Surface water samples were collected at three locations in Newman Creek in order to evaluate if plant activities may have impacted the stream quality. Samples were collected from points upstream of the lagoon, adjacent to the lagoon, and downstream of the lagoon (collected at the plant discharge). Sample locations are shown in Figure 2-2. Specific protocols for surface water sampling are provided in Appendix B. Results are discussed in Section 3. Additionally, results of surface water velocity measurements are presented in Section 3.6.2.3.

2.6.3 Stream Sediment Sampling

Five stream sediment samples were collected in Newman Creek in order to evaluate potential impacts on the creek sediments. Three samples were taken at the same locations as the surface water samples, and two samples were collected from two additional locations along the creek. Stream sediment sample locations are shown in Figure 2-2. Specific protocols used for the stream sampling are provided in Appendix B. Results are discussed in Section 3.

2.7 AQUIFER TESTING

During December 1988, a recovery/drawdown test was performed to determine aquifer properties, such as transmissivity and storativity, as well as to evaluate qualitatively the extent of hydrologic connection between the bedrock aquifer and the overlying unconsolidated aquifer. These data were used to evaluate groundwater flow rates and also for computer modeling.

The aquifer test was performed by shutting off and then restarting the production well (W-10) and monitoring resulting recovery and drawdown rates in monitoring wells on and around the site. Water levels in six wells (R-1, R-2, R-3, D-4-30, L-5, I-2) were measured with electric transducers and recorded by an SE-2000 and an SE-1000 data logger. L-5 was monitored instead of the originally planned L-1, in order to monitor the effect of pumping on water levels near the creek. Water levels in all the other site wells, including W-10, were measured by hand at periodic intervals.

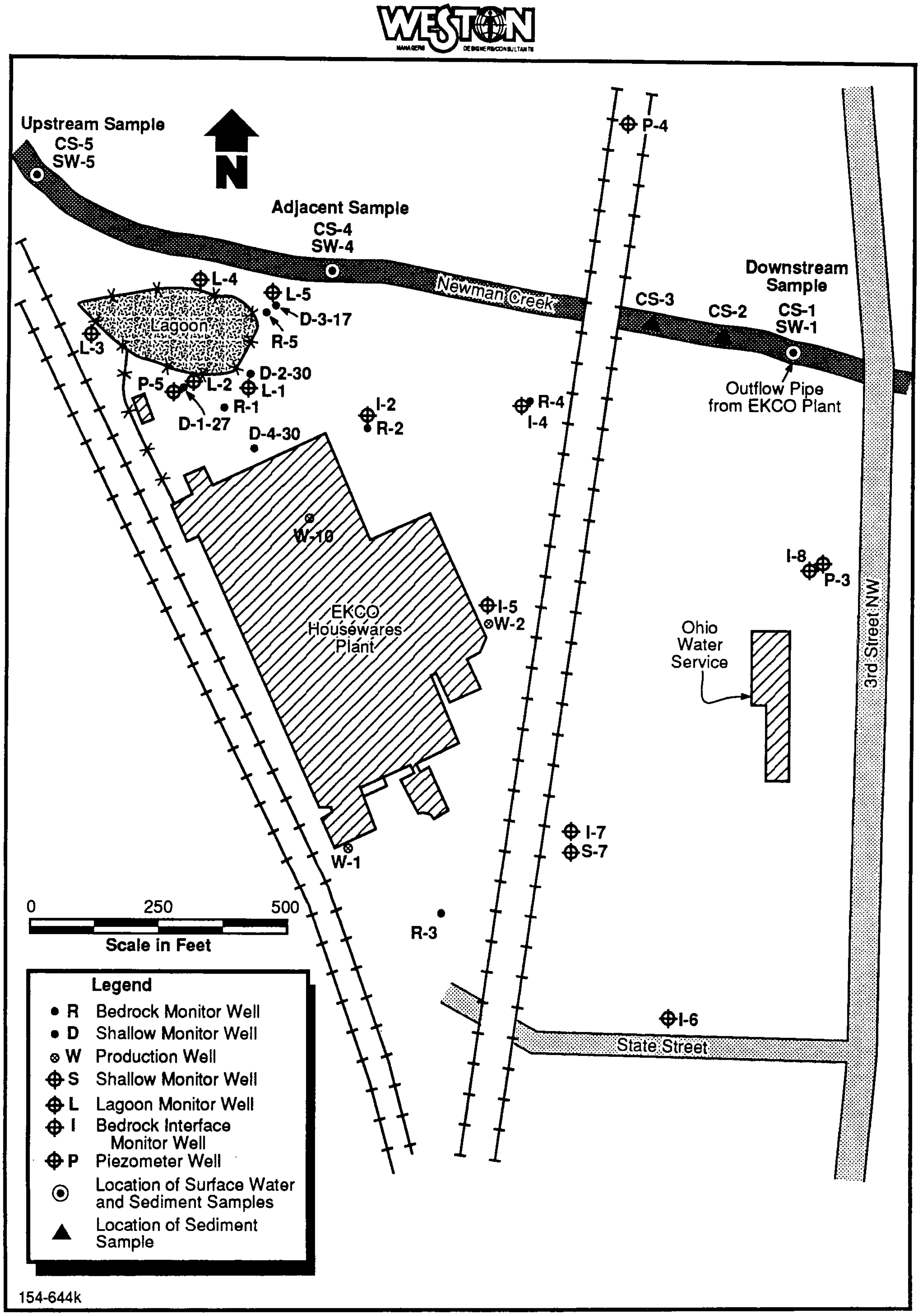


FIGURE 2-2 SURFACE WATER AND STREAM SEDIMENT SAMPLE LOCATIONS

Background water levels were measured for 24 hours before the test. Following this 24-hour interval, W-10 was shut off and remained off for 72 hours, at which time water levels in the observation wells had reached near static conditions. (Seventy-two hours was a restriction imposed by plant production requirements.) Following the 72-hour shut down, pumping was then resumed in W-10 and drawdown was measured in all the wells for 48 hours, at which time water levels had very nearly reached pre-test levels. Results of the aquifer testing are incorporated in the discussion of site hydrogeology in Section 3, and have been used in the computer modeling, discussed in Section 4.

SECTION 3

RESULTS OF FIELD INVESTIGATION

3.1 INTRODUCTION

Section 3 presents and discusses the results of Phase II field activities conducted at EKCO during the months May through December 1988. These activities included:

- Monitoring well installation.
- Surveying.
- Soil gas sampling.
- Soil borings and soil sampling.
- Water and sediment sampling.
- Aquifer testing.

Specific conclusions based on field and laboratory investigations and data evaluation are presented in Section 5.

3.2 MONITORING WELL INSTALLATION

During May, June and July 1988, 16 monitoring wells were installed by Bowser-Morner Drilling Co. under subcontract to WESTON at the EKCO facility. These wells consisted of one bedrock well (R-well), six interface wells (I-wells), three piezometers (P-wells), five lagoon wells (L-wells), and one shallow well (S-well) (Figure 2-1). The purpose of these wells was to characterize hydrogeologic conditions at the EKCO facility, and to evaluate groundwater quality. Geologic well logs and construction summaries for each well are presented in Appendix C. All screened wells were completed using standard gravel pack and grouting techniques and development procedures, pursuant to the Ground Water Assessment Plan (March, 1988).

The bedrock well (R-5) was cased two feet into bedrock with 6-inch (I.D.) low carbon steel casing, and was completed as an open hole well to a total depth of 60 feet. The six interface wells (I-2, I-4, I-5, I-6, I-7, I-8) were drilled to the top of bedrock with total depths ranging from 40 feet (I-2) to 130 feet (I-6). I-wells were constructed using 4-inch (I.D.) low carbon steel casing, with 10-foot stainless steel screens and stainless steel couplings.

Three, 2-inch (I.D.) threaded, flush-joint PVC piezometers were installed (P-3, P-4, P-5). P-4 and P-5 were drilled to the bedrock top with total depths of 108 feet and 35 feet, respectively. P-3, adjacent to well I-8, was completed in unconsolidated material with a total depth of 43 feet. P-3 and P-4 have 10-foot screens and P-5 has a 5-foot screen. The screen bottom of P-3 is 26 feet above the screen top of I-8.

The five lagoon wells (L-1 through L-5) were installed around the perimeter of the lagoon. These are 4-inch (I.D.) low carbon steel cased wells with 10-foot stainless steel screens. Total depths range from 16 feet (L-4) to 42 feet (L-1). One additional shallow well (S-7) was installed adjacent to I-7. S-7 is a 4-inch (I.D.) low carbon steel cased well with a 10-foot stainless steel screen. The screen bottom of S-7 is 13 feet above the screen top of I-7; the total depth of S-7 is 38 feet. The specific monitoring well installation protocol is presented in Appendix C. Figure 3-1 provides a schematic representation summarizing each type of well construction.

3.3 SURVEYING

In August 1988, WESTON subcontracted Buckeye Surveying Services, Inc. to do a complete survey, determining horizontal and vertical locations of all 29 wells (observation and production) and locating major physical structures (i.e., buildings) on the site. Table 3-1 presents a summary of survey results. The reference USGS Bench Mark location is shown in Figure 2-1.

3.4 SOIL-GAS RESULTS

Soil gas sample locations are shown in Figure 3-2. The soil-gas results are tabulated in Appendix D and are displayed as Total VOCs in Figure 3-3. TCE was the most prevalent compound detected in the soil gas samples.

As can be seen on Figure 3-3, three major areas of elevated VOCs in shallow soils were identified by the soil gas sampling effort. These three areas were along the southwestern corner of the plant, at the north end of the plant, and the area around SB-9.

Along the southwestern corner of the plant, both TCE and 1,1,1-TCA were detected during the soil gas sampling. TCE was more commonly present and at higher concentrations. Possible sources of contamination in this area include a solvent storage tank and pipeline (see Figure 3-4). Losses of solvents on a routine basis during normal operation of the system may be a cause of the levels detected in the soil gas samples.

Soil gas results in the northern corner of the plant indicates several areas where shallow soils show elevated VOC concentrations. The highest concentrations in the soil gas correspond with the highest VOC concentrations seen in shallow groundwater.

Shallow soil VOC contamination at the northern end of the plant may have occurred as a result of activities at the tank farm in the vicinity of soil gas sample point SG-24 (Figure 3-4). Further investigation may be warranted to define the extent of contamination in this area.

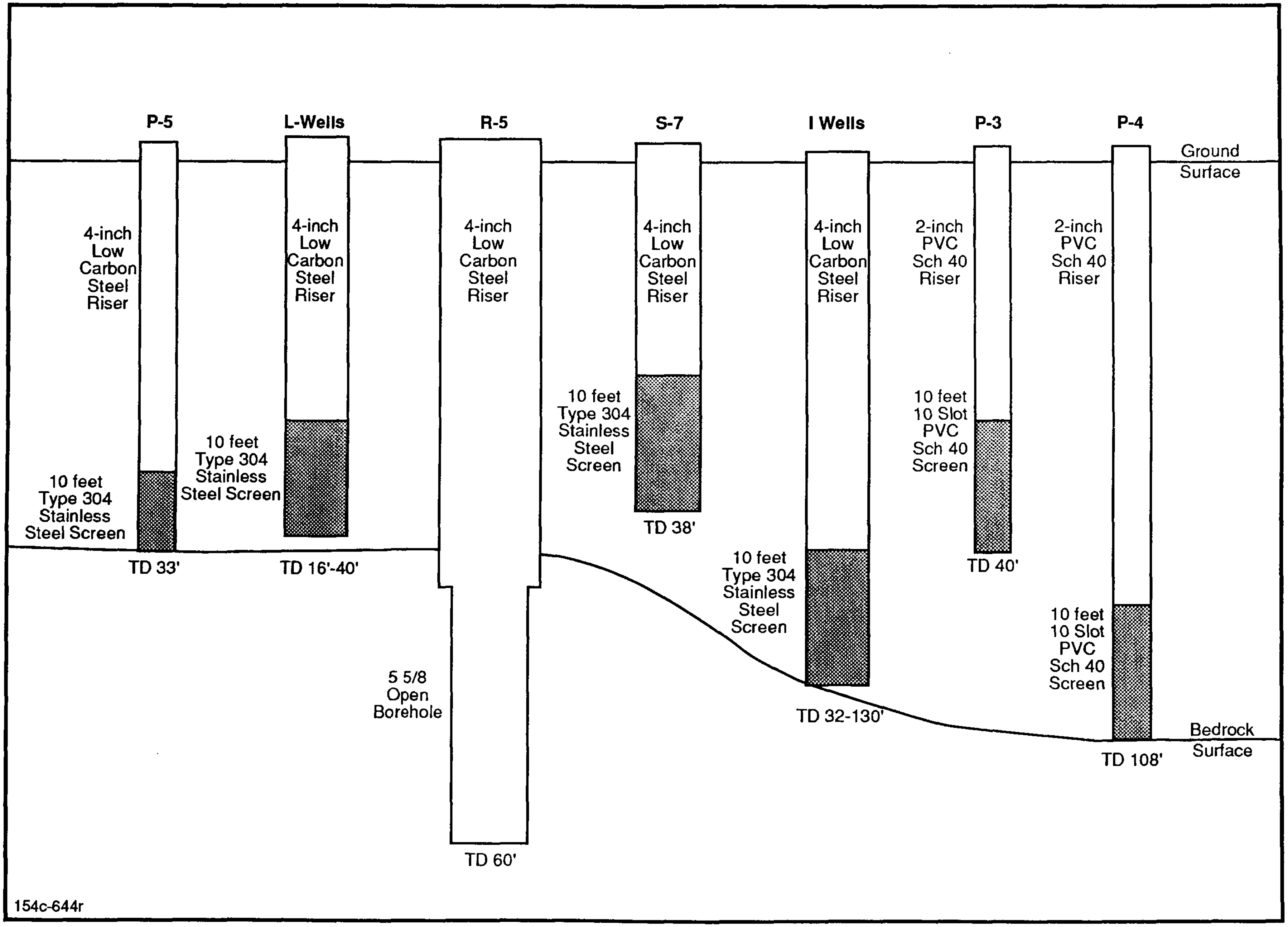


FIGURE 3-1 WELL CONSTRUCTION SCHEMATIC

Table 3-1

Survey Results

Well Number	North	East	T.I.C.	Elevations T.O.C.	Ground	Others
D-1-27	6065.338	5289.507	948.09	948.26	946.2	
D-2-30	6096.099	5415.059	946.16	946.31	944.1	
D-3-17	6215.142	5450.022	936.81	936.99	934.2	
D-4-30	5946.105	5419.603	949.69	949.72	947.4	
I-2	6008.795	5636.674	946.40	946.69	944.0	
I-4	6036.420	5938.350	933.23	933.37	932.3	
I-5	5649.680	5878.506	946.13	946.13	943.8	
I-6	4880.413	6247.524	940.62	940.62	937.9	
I-7	5228.139	6052.270	940.04	941.06	939.4	
I-8	5738.442	6504.282	931.51	933.23	931.1	
L-1	6090.781	5409.180	946.33	946.77	944.2	
L-2	6068.230	5295.739	947.57	948.08	946.2	
L-3	6157.633	5113.546	946.91	947.37	946.0	
L-4	6258.417	5306.089	938.22	938.70	935.9	929.40 T/Water
L-5	6226.026	5444.885	936.98	937.46	934.7	929.07 T/Water
P-1-84	5945.111	5444.624			946.8	948.66 T/Collar
P-2-84	6102.295	5430.822			943.2	945.84 T/Collar
P-3	5740.736	6515.588	933.68	933.87	930.9	
P-4	6589.465	6120.430	938.49	938.63	936.7	
P-5	6062.376	5284.706	948.43	948.60	946.2	
R-1	6020.037	5357.662		946.91	946.0	946.93 T/Cap
R-2	5996.009	5635.598		946.32	944.3	946.38 T/Cap
R-3	5081.521	5806.276		947.14	945.4	947.16 T/Cap
R-4	6038.936	5947.316		933.28	932.5	933.31 T/Cap
R-5	6208.371	5444.704		937.78	934.8	
S-7	5222.674	6052.243	940.94	941.37	939.4	
W-1	5199.971	5617.222				947.26 Fl.Elev.
W-2	5624.425	5883.811				945.29 T/St pl.
W-10	5819.613	5530.858				942.01 T/Well

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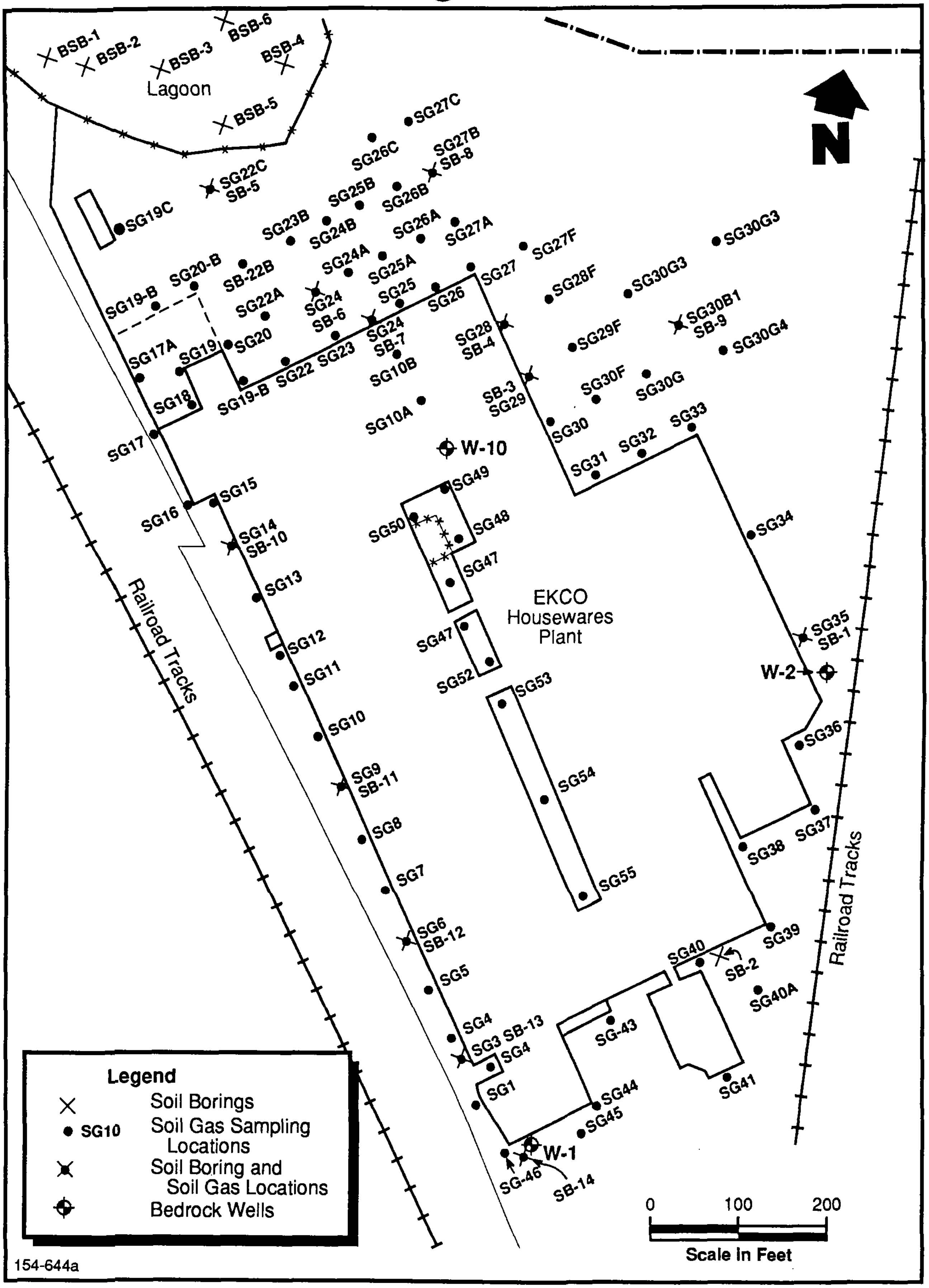

FIGURE 3-2 SOIL BORING AND SOIL GAS SAMPLING LOCATION MAP

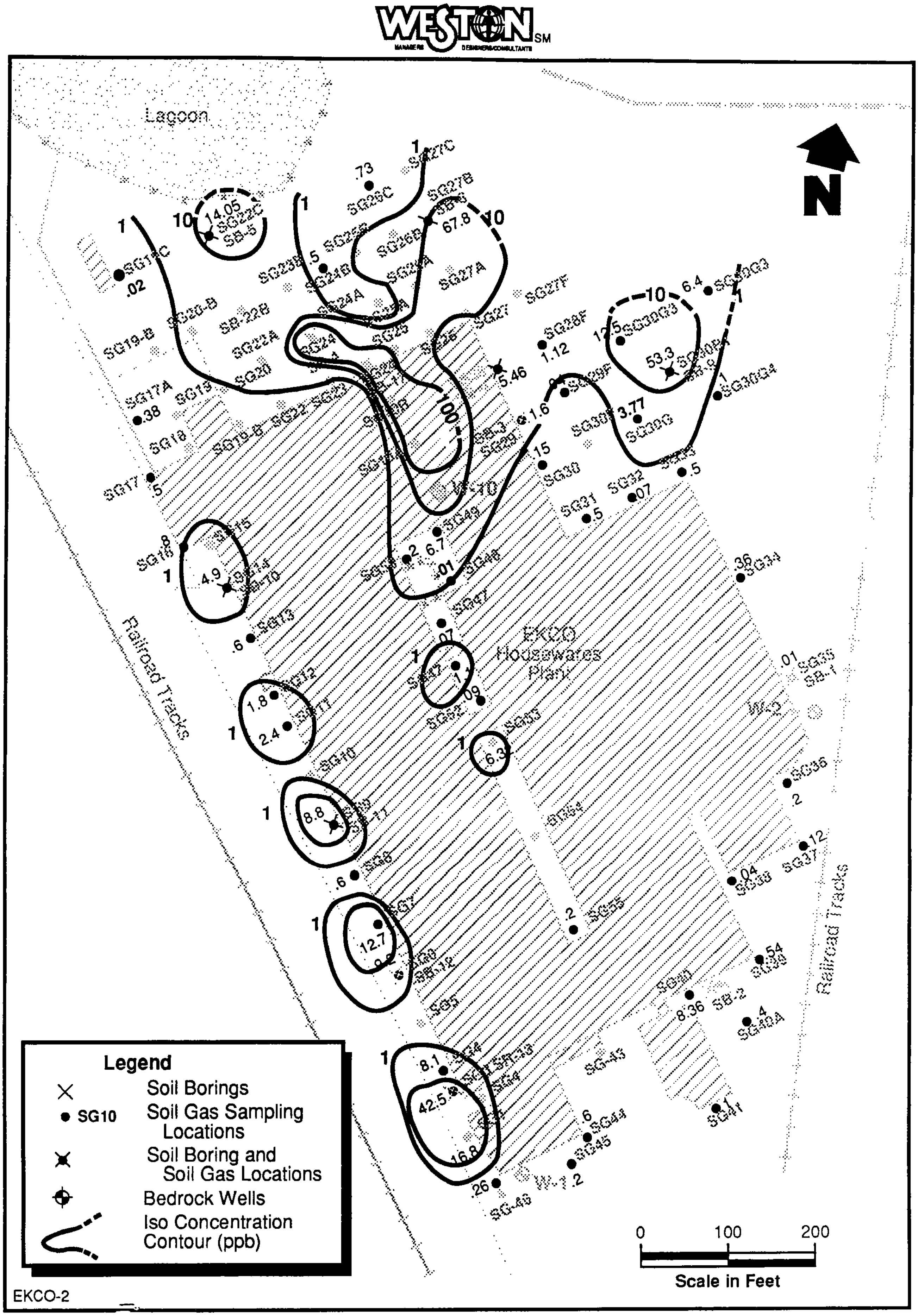

FIGURE 3-3 SOIL GAS SAMPLING TOTAL VOCs (PPB) CONCENTRATION

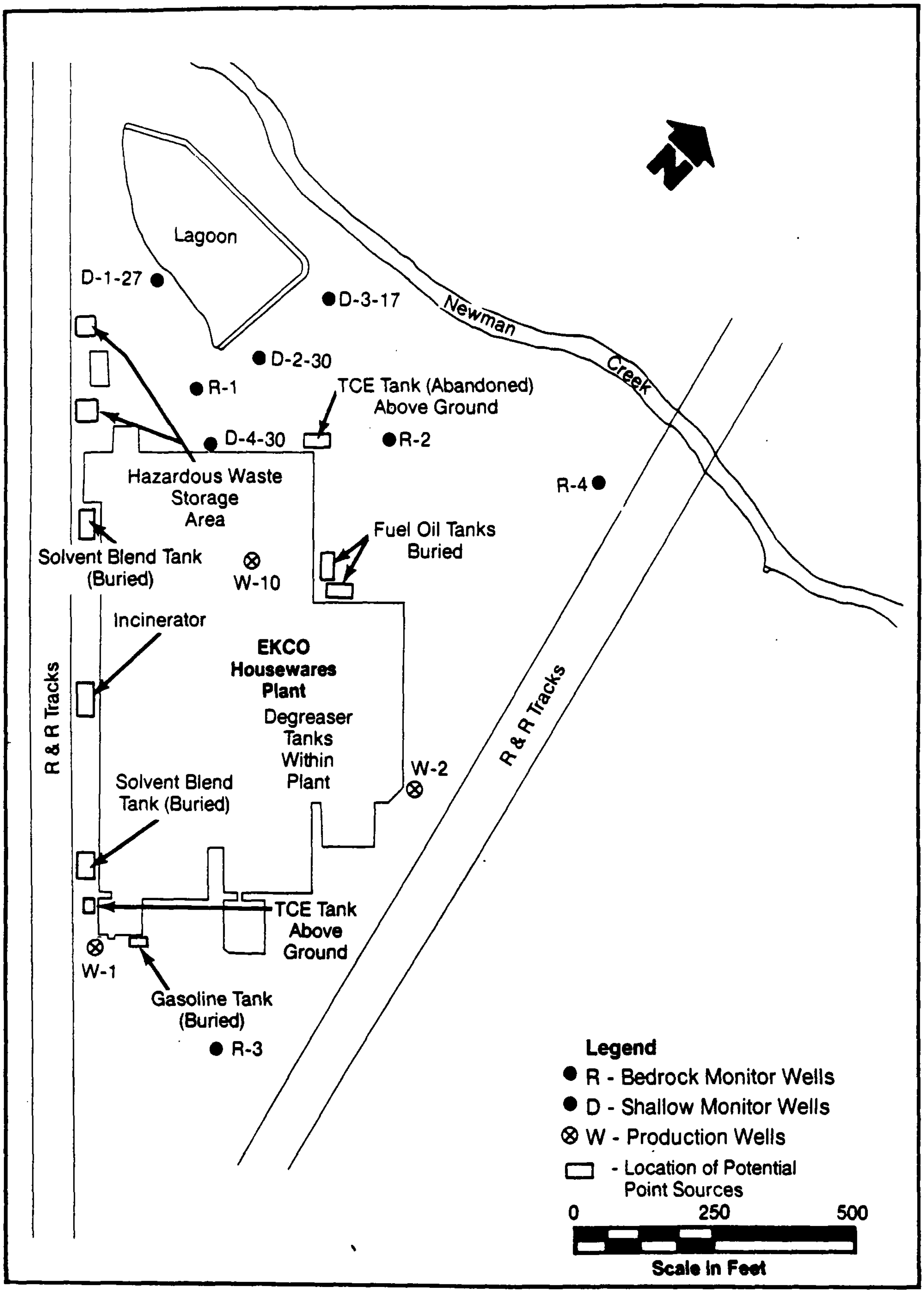

FIGURE 3-4 POTENTIAL POINT SOURCE LOCATIONS EKCO HOUSEWARES, INC., MASSILLON, OHIO

Again as seen on Figure 3-3, several areas of soil VOC contamination exist on-site. These areas may represent small spills, or perhaps reworking or relocation of soils from contaminated areas, or may indicate contaminant migration. The presence of 1,1-dichloroethene (1,1-DCE) in a number of soil gas samples from these more limited areas, as well as in several samples from the relatively large impacted area to the north of the plant, suggests soil contamination in these areas to be at least in part a result of activities having occurred in the past, allowing time for dehalogenation of TCE and/or 1,1,1-TCA. More recent solvent losses may also have occurred, as the concentrations of 1,1-DCE are low, relative to the concentrations of TCE and 1,1,1-TCA.

3.5 SOIL BORING RESULTS

3.5.1 Soil Borings Volatile Organic Compounds

Soil borings were performed in areas where soil gas results indicated potential VOC contamination as a means of pinpointing potential source areas, of quantifying levels of organic and inorganic soil contamination, and of developing a vertical profile of soil contamination. Soil boring locations are shown on Figure 3-2. Results of analysis of soil samples from the soil borings are summarized in Appendix D. Soil sampling protocols followed are presented in Appendix C. Soil boring logs are presented in Appendix F.

Results of VOC analysis of soil samples suggests overall concurrence with soil gas sampling results. Based upon the soil boring samples, the three major areas containing elevated VOCs in soil are: 1) the southern corner of the building near the solvent storage tank, 2) north of the building and south of the lagoon, and 3) the area around SB-9. Although TCE and 1,1,1-TCA were the primary VOCs detected, as was the finding in the soil gas analysis, two additional compounds, toluene and 1,2-dichloroethene (1,2-DCE), were detected in soil boring samples.

Results of VOC analysis of soil samples are listed as total VOC concentration versus depth in Table 3-2. This table illustrates, based upon the soil boring results, the vertical distribution of VOCs with depth in each of the areas of concern around the site.

Several trends are apparent based upon the soil VOC analysis. Near the southern corner of the building, and near SB-9, relatively high, near-surface VOC concentrations suggest surface spills as possible sources; the lack of high concentrations in deeper samples suggest relatively recent occurrences and/or a lack of mobility in the soil. On the other hand, significant contamination of soils to depths of at least 14 to 16 feet in the area north of the building and south of the lagoon, combined with relatively high VOC concentrations at depths of four

Table 3-2

Soil Boring, Total Volatile Organic Compounds (PPB)

Depth	Northern Borings								Southern Borings					
Feet	SB-3	SB-4	SB-5	SB-6	SB-7	SB-8	SB-9	SB-10	SB-1	SB-2	SB-11	SB-12	SB-13	SB-14
0-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-4	60	-	326	220	964	228	1338	227	298	65	No Samples		140628	123
4-6	-	53	-	-	3183	-	-	-	-	-			-	-
6-8	137	-	-	655	-	753	-	-	118	-			267	199
8-10	-	-	-	-	430	-	-		-	104			-	232
10-12	245	84	51	122	251	1096	-		83	146			706	-
12-14	-	307	-	80	539	-	281		-	-			-	
14-16		-	-	637	2268		-							
16-18			-	219	-									
18-20			84	-										
20-22			-	-										
22-24				-										
24-26				97										

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to six feet in the same area, suggests a more complex history than that indicated in the other areas, perhaps involving numerous sources or spill/loss events.

3.5.2 Soil Boring Inorganic Results - Cadmium, Chromium, and Lead

Results of soil boring sample analyses for cadmium, chromium and lead are listed in Table 3-3 through Table 3-5 and are discussed separately from the other inorganics because of their reportedly toxic nature and their separate treatment in point 10 of the closure plan review guidance (10 December 1985.) WESTON soil boring metal results for cadmium, chromium and lead were analyzed to determine if distinct populations of the metals could be differentiated among the site subsurface materials, (fill, lagoon, and natural). To accomplish this, the extent of the fill was determined through examination of the boring logs to evaluate whether a boring was installed in a fill area, natural or lagoonal material and whether the soil samples were analyzed for metals in that boring (Tables 3-3 through 3-5). All of the samples for each sample group (natural, fill or lagoon) were then summed, averaged and standard deviations were calculated. Calculated values were then compared between the groups. Results are discussed below.

The mean values for cadmium in the natural material and in the fill material were very similar, suggesting no significant difference between the two groups. When comparing these mean values and associated ranges to the maximum Ohio Farm soil value of 2.9 mg/kg, a large portion (the upper two standard deviations) of each population is above this value. The average cadmium concentrations for the lagoon material (703.8 mg/kg) is two orders of magnitude greater than the other average values (fill, 8.2 mg/kg; natural, 2.3 mg/kg). This is significant only in that the lagoon material has higher concentrations of cadmium than the surrounding fill or natural material and can be distinguished from the other materials.

The chromium population consists of two groups. Native materials had the lowest mean, 58 mg/kg, more than two times higher than the Ohio Farm soil highest value of 23 mg/kg. The fill material and lagoon material both have means an order of magnitude above the mean value for the natural materials, but the range of the lagoon material has a higher standard deviation and a wider range. These results suggest that the natural background level for chromium at the site is above the Ohio Farm soils limit which might otherwise be considered as background.

The lead population consists of three groups. The mean of the natural material is 39 mg/kg, which corresponds with the upper limit of the Ohio Farm soils limit. This suggests that native materials have a background range at the site that extends above the Ohio Farm soil limit. The mean concentration of lead

Table 3-3

Natural Soil Borings
Cadmium, Chromium and Lead Concentrations

Depth (Feet)	"Natural" Soil Borings (mg/Kg) SB-2	SB-3	SB-10	SB-13	SB-14
2					
	.851	1.79	2.75	.903	1.82
	11	60.9	14.3	5.44	21.0
	21.6	44.6	44.3	30.2	35.9
4					
6					
		1.19		.761	10.5
		13.7		8.77	7.86
		22		12	162
8					
	1.44				1.88
	7.67				9.71
	10.4				55.7
10					
	1.40	1.46		2.72	
	8.88	15.3		13.	
	7.98	37.8		22.5	
12					

Note: Metals concentrations are listed in the following order:

Cadmium
Chromium
Lead

Ohio Farm Soil Concentration means are:

Cadmium = 2.9 ppm
Chromium = 23 ppm
Lead = 39 ppm

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Table 3-4

Lagoon Soil Borings
Cadmium, Chromium and Lead Concentration

Depth (Feet)	Lagoon Soil Borings (mg/kg) BSB-1	BSB-2	BSB-3	BSB-4	BSB-5	BSB-6
	19.2	1370	18.9	369	8320	517
	262	405	152	169	400	188
	900	5100	990	1400	19000	2400
2						
	9.13	6.1	1.24	<.371	7000	3.52
	103	11.8	384	4.52	233	843
	72	42	36	22	23000	29
4						
	6.73	136	1.21	51.8	282	13.4
	17	70.4	527	54.5	923	14.1
	38	670	43	570	1100	71
6						
	215	<.381	3790	1560	725	5400
	295	8.92	264	354	482	743
	860	20	13000	93	6100	18000
8						
	1611	84.6	<.369	13.4	.46	53.4
	61.5	8.72	6.55	16.0	8.43	12.6
	91	320	36	93	22	180
10						
	.789	11.1	5.23		.941	8.43
	4.74	7.15	11.6		8.7	6.1
	42	58	39		22	52
12						
		2.7	8.06	<.375	3.8	19.5
		7.6	15.2	10.2	24	12.3
		33	56	39	40	79
14		<.396	2.27	8.52	14.3	5.23
		6.81	4.44	11.4	20.9	8.57
		36	16	36	70	42
16						

Note: Metals concentrations are listed in the following order:
Cadmium
Chromium
Lead

Ohio Farm Soil Concentration means are:
Cadmium = 2.9 ppm
Chromium = 23 ppm
Lead = 39 ppm

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Table 3-5

Fill Soil Borings Cd, Cr, Pb Concentrations (mg/Kg)

Depth (Feet)	"Fill" Soil Borings SB-1	SB-4	SB-5	SB-6	SB-7	SB-8	SB-9
2	1.25		1.21	1.84	1.25	.886	8.34
	61		39.6	15	66.2	116	47.8
4	78.4		24.5	152	927	261	189
		1.60			2.15		
		59.4			2.15		
		73.3			118		
6	4.81			.986		1.71	.871
	8.08			17.5		32.6	55.6
8	292			54		329	1540
					1.48		
					12.5		
					13.1		
10	.837	.841	2.26	1.22	.652	3.06	
	15.4	12.8	10.4	16.7	12.6	41.8	
12	29.8	90.5	116	41.4	30.6	250	
		.927		.866	.976		1.53
		13.1		8.81	42.6		63.6
14		135		31.7	260		63.6
				.859	1.17		
				10.8	183		
16				27.4	221		
				1.32			
				14.2			
18				12.8			
			1.26				
			13.4				
20			6.24				
22							
24				1.41			
				2.34			
26				6.20			

Note: Metals concentrations are listed in the following order:
Cadmium
Chromium
Lead

Ohio Farm Soil Concentration means are:
Cadmium = 2.9 ppm
Chromium = 23 ppm
Lead = 39 ppm

in the fill materials, 192 mg/kg, is an order of magnitude higher than the natural material mean value. The lagoon material mean, 2,110 mg/kg, is an order of magnitude above the fill material mean. The ranges for the groups also increase by an order of magnitude as one moves from the natural to fill to lagoon material.

The lagoon deposits typically show the highest concentrations of cadmium, chromium and lead. If these metals were detected in the groundwater, particularly in the groundwater in the vicinity of the lagoon, the lagoon would be the suspected source. However, the site groundwater samples did not have any cadmium, chromium or lead values above the drinking water limits. The groundwater metal results are discussed in Subsection 3.6.1.2.

3.5.3 Soil Boring Results - Other Metals

Three other heavy metals discussed in the Ohio Farm soils report besides cadmium, chromium and lead are copper, nickel, and zinc. The distribution of copper, nickel and zinc is similar to the distribution of the other heavy metals (Cd, Cr, Pb). Concentrations of copper, nickel and zinc however, are not above the Ohio Farm soil limit as often (copper above farm soil value in 25 of 51 samples, nickel in 15 of 51, and zinc in 17 of 51). In comparing the distribution of heavy metals in soils with the distribution of VOCs in soils, the areas of elevated metals concentrations appears to coincide with the area of elevated VOC concentrations in the soil borings. As elevated heavy metals concentrations are obviously typical of the fill materials present to depths of greater than 10 feet across much of the site, the significance of the metals should be determined based upon concentrations detected in groundwater samples. All results in groundwater for the heavy metals were below Federal drinking water standards (primary).

3.6 WATER AND SEDIMENT SAMPLING RESULTS

3.6.1 Groundwater

3.6.1.1 Groundwater VOC Results

The results of the groundwater sampling are tabulated in Appendix D and are displayed in Figure 3-5 through 3-11. The VOCs commonly detected were TCE, 1,1,1-TCA, 1,2-DCE, 1,1-DCA, 1,1-DCE, total BTXE compounds and vinyl chloride. TCE and 1,1,1-TCA were the most most common VOCs and were typically at the highest concentrations.

The distributions of the VOCs listed above have been mapped and are shown on Figure 3-5 through 3-11. All bedrock and interface well VOC sample concentrations are presented and interpretive contours have been drawn.

Based upon the Phase II VOC results, all of the contaminant plumes in the interface and bedrock wells for the above compounds, except for total BTXE, are similar. The major plume is located primarily between the lagoon and the north end of the plant, with the highest concentrations detected at well D-4-30. The contaminants are primarily in the rock wells near well D-4-30 and the interface wells, suggesting a primary source of the contaminants in the vicinity of well D-4-30.

Groundwater in the southern part of the site, near wells W-1 and R-3, indicate a different suite of VOCs as compared to the next closest well, I-7. Detected in well I-7 were 1,1,1-TCA, 1,2-DCE and total BTXE compounds. Wells W-1 and R-3 did not show the presence of these VOCs, suggesting different conditions or sources of contamination exist on site in the southern part of the site as compared to the off-site area to the east. Well I-7 also showed the highest detected 1,1-DCA concentrations, inferring either the well is near a source of 1,1-DCA, or breakdown of more highly chlorinated VOCs.

Well I-5 is approximately equidistant from the two areas with the highest concentrations of contaminants (the area north of the plant and the area of well I-7). The contamination at I-5 could be related to either contaminated area, because in both areas groundwater has shown VOC concentrations greater than that seen in well I-5. Current or past pumping of wells could have caused this distribution, or another source may have been the cause of the contamination detected in I-5.

Well I-8 is the furthest off-site well located near the Ohio Water Service Co.. VOCs detected in Well I-8 were the following amounts: 0.96 ppb of TCE and 3.8 ppb of 1,1-DCA. I-8 also had the highest total BTXE compound concentration detected in the interface or rock wells, suggesting it is closer to a BTXE source that is apparently off-site. No underground or aboveground fuel storage tanks are known of in the immediate vicinity of Well I-8. However, other potential sources are present in the area, including the inactive landfill and other industrial facilities, such as the automotive junkyard (see Figure 1-1).

The shallow wells are primarily located near the lagoon. These wells show VOC contamination at approximately the same order of magnitude as the nearby bedrock wells, except for well D-4-30. D-4-30 had some of the highest concentrations of contaminants, particularly TCE and 1,1,1-TCA, suggesting a possible shallow source for VOCs in groundwater near D-4-30. This conclusion is substantiated by the soil-gas and soil boring results. Because the more highly chlorinated VOCs (TCE, 1,1,1-TCA) represent a greater precentage of the total VOC concentrations in Well D-4-30 relative to other deeper, further off-site wells, an ongoing or more recent source of contamination is likely close to the plant.

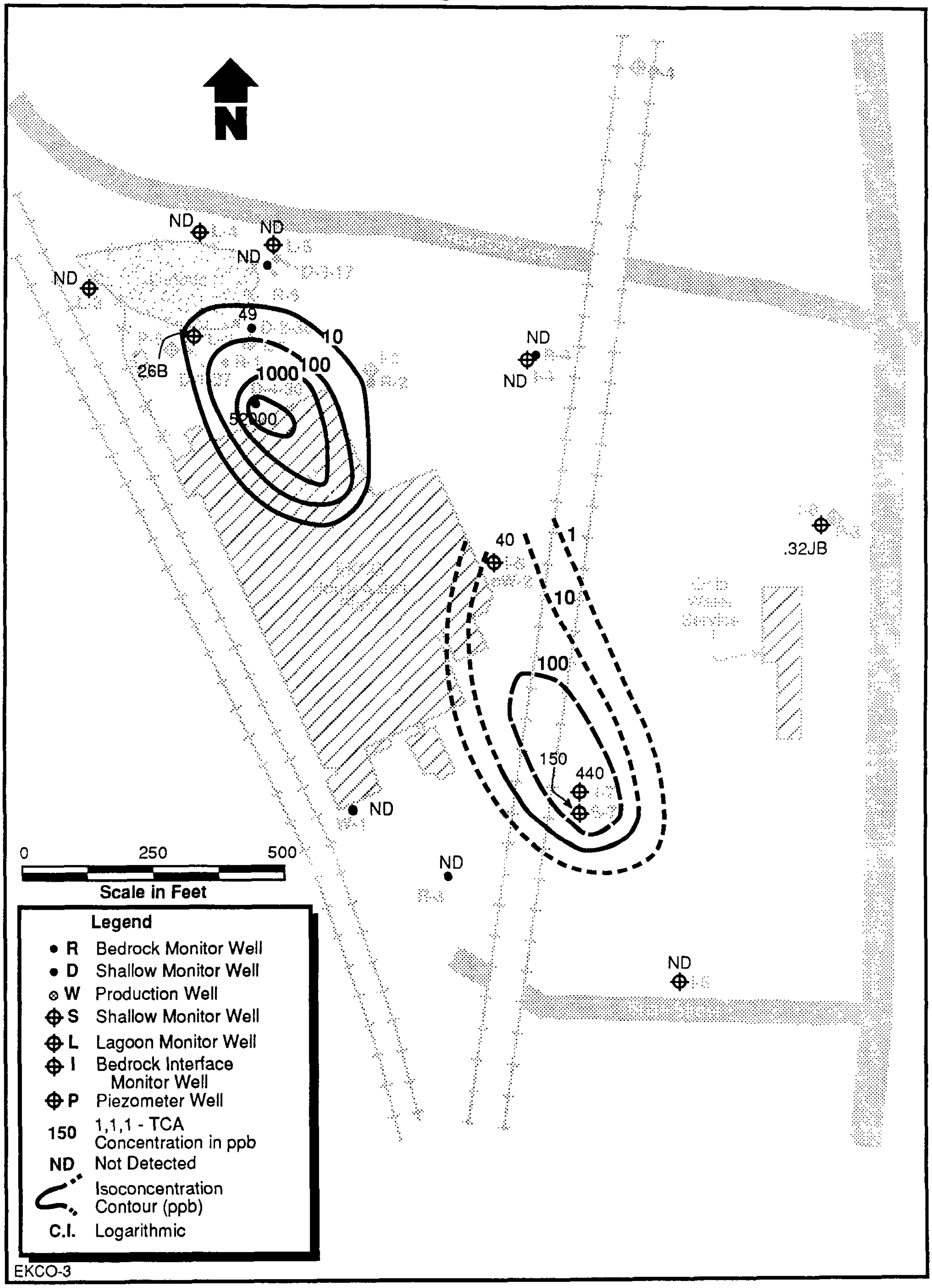


FIGURE 3-5 1,1,1 - TCA CONCENTRATIONS (PPB) IN GROUNDWATER

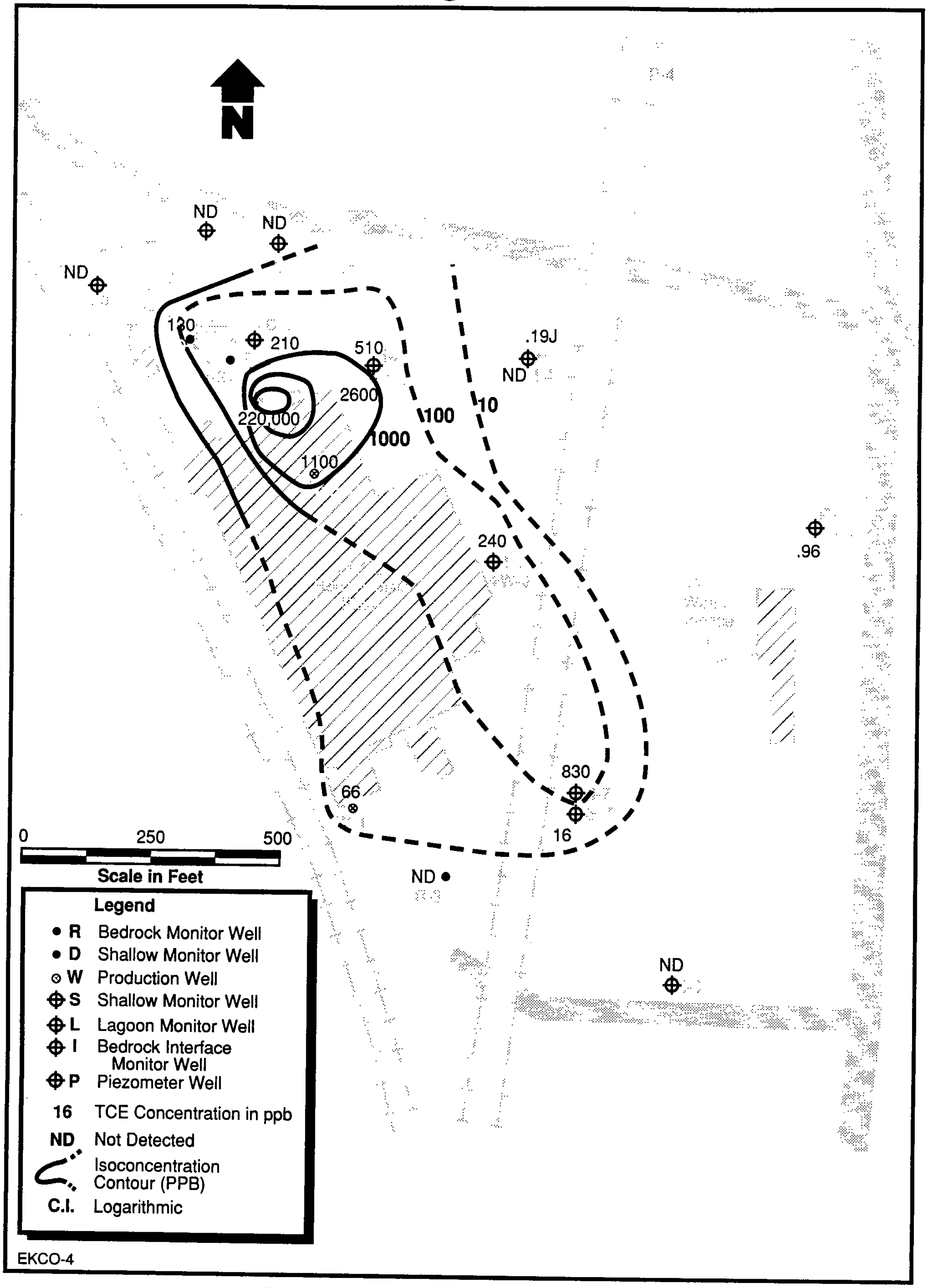


FIGURE 3-6 TCE CONCENTRATIONS (PPB) IN GROUNDWATER

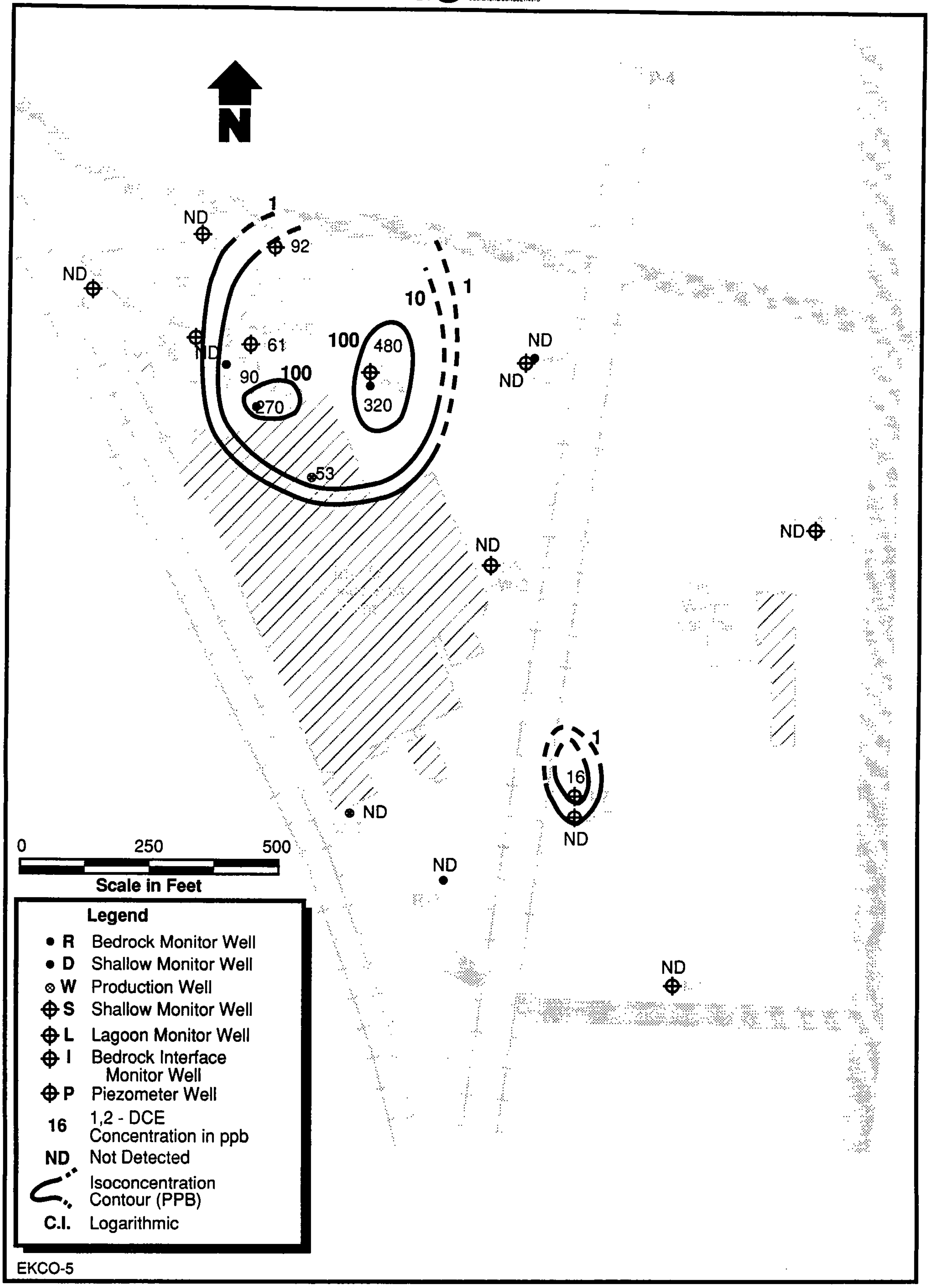


FIGURE 3-7 1,2 - DCE CONCENTRATIONS (PPB) IN GROUNDWATER

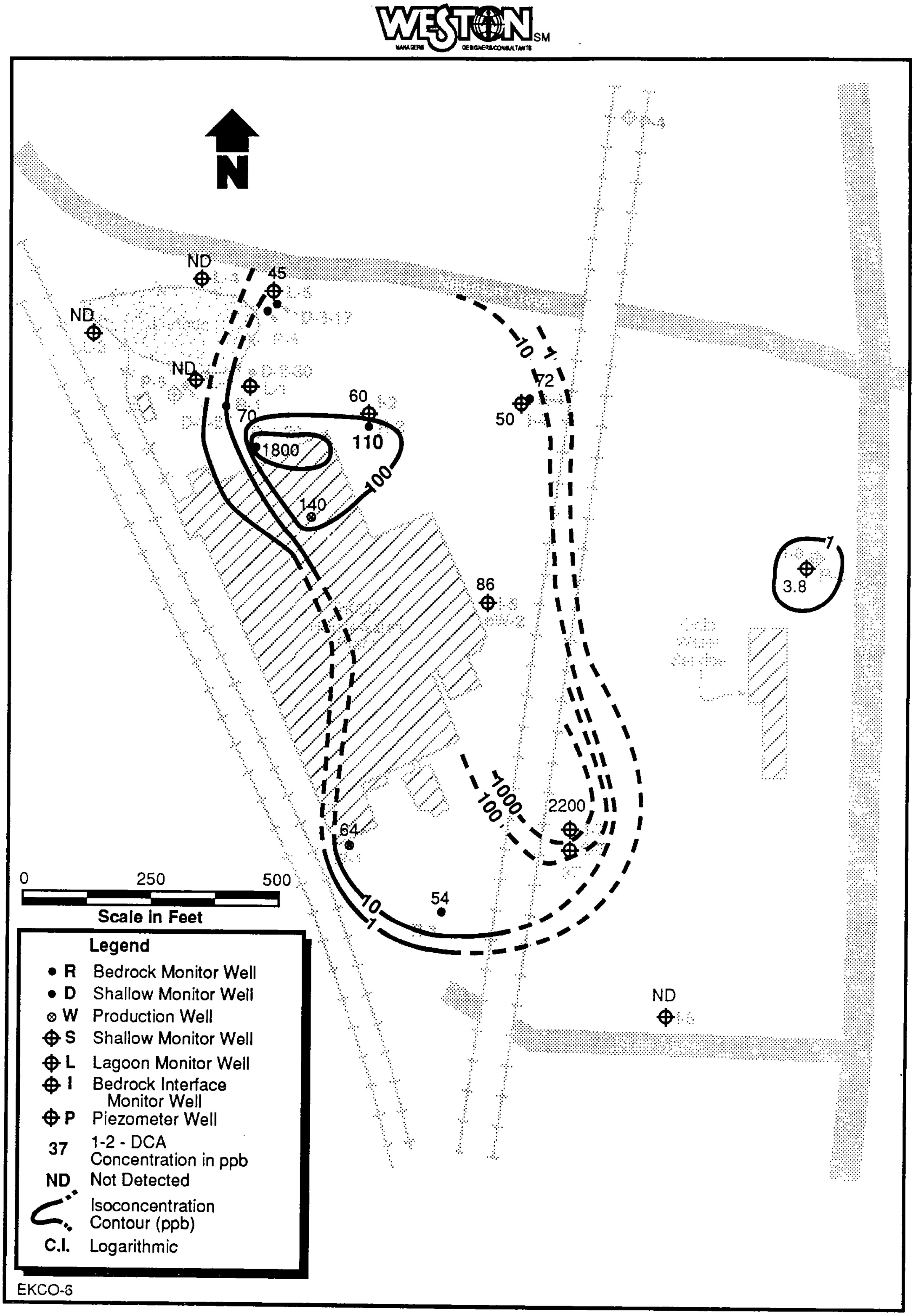


FIGURE 3-8 1,1 - DCA CONCENTRATIONS (PPB) IN GROUNDWATER

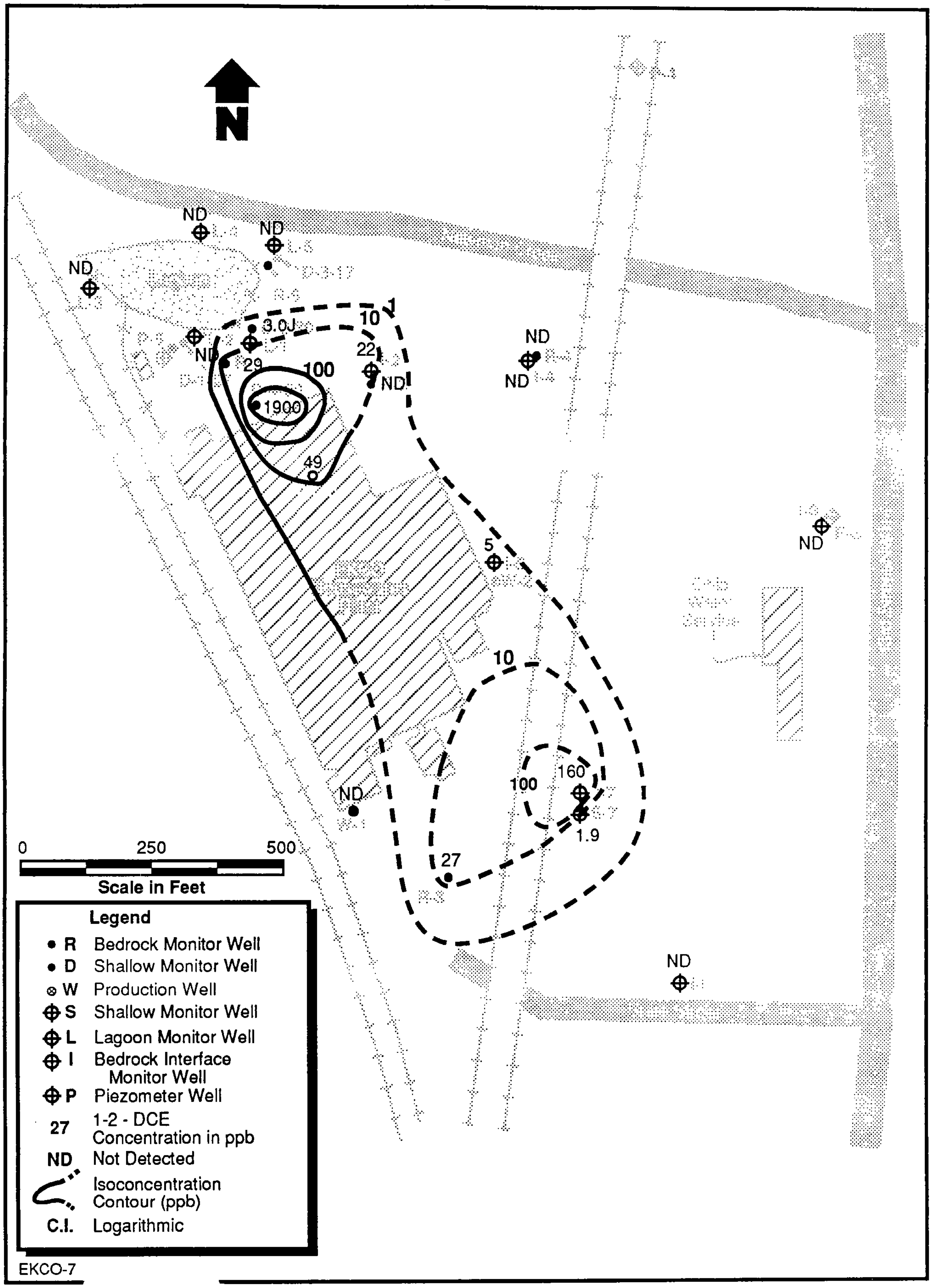


FIGURE 3-9 1,1 - DCE CONCENTRATIONS (PPB) IN GROUNDWATER

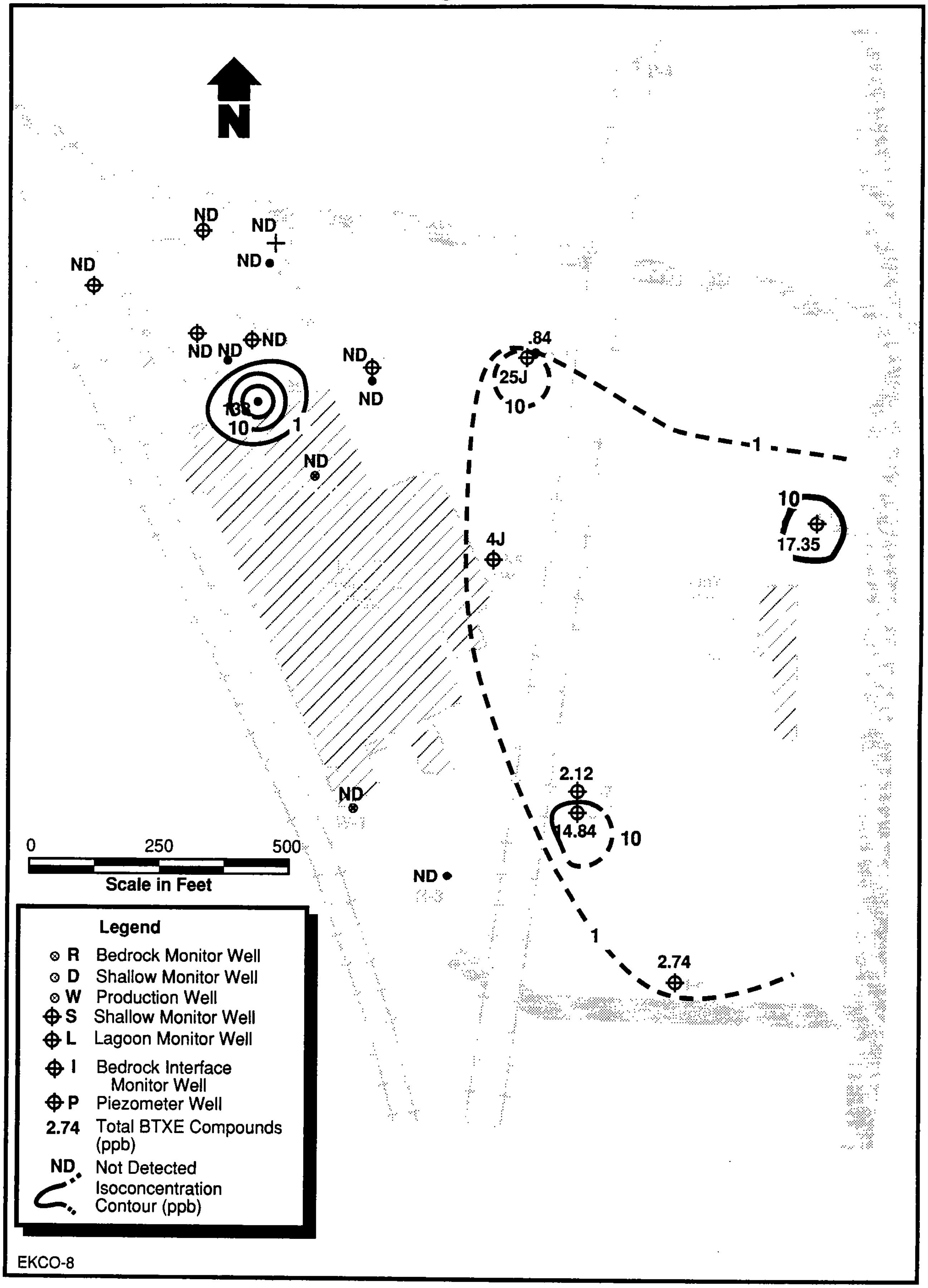


FIGURE 3-10 TOTAL BTXE COMPOUND CONCENTRATIONS (PPB) IN GROUNDWATER

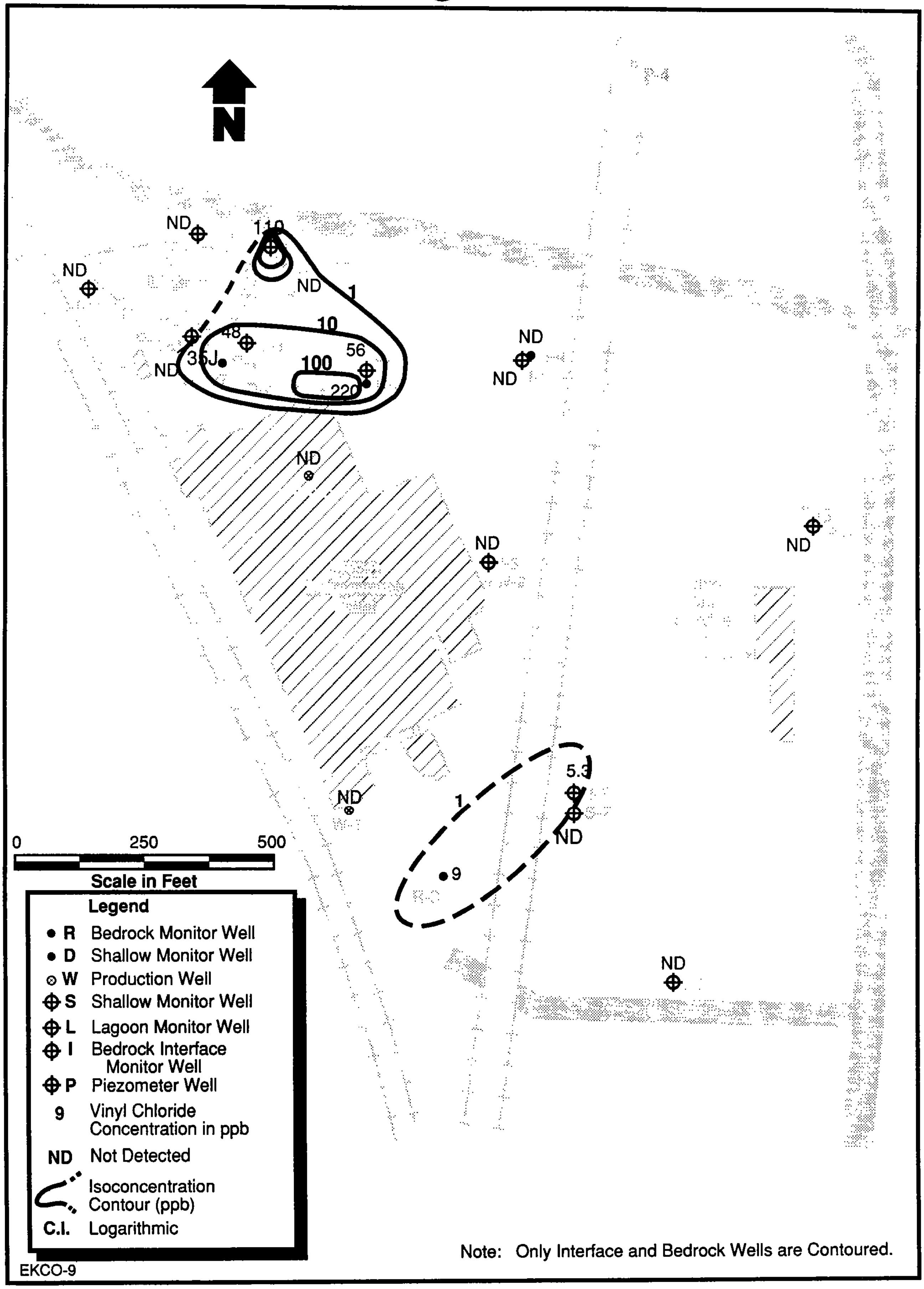


FIGURE 3-11 VINYL CHLORIDE CONCENTRATIONS (PPB) IN GROUNDWATER

During the groundwater sampling program 15 of the monitoring wells (I-2, I-4, I-5, I-6, L-1, L-2, L-3, L-4, L-5, R-1, R-2, R-3, R-4, R-5, D-4-30) were sampled for Dense Nonaqueous Phase Liquids (DNAPLS). A BAT HYPOBROBE SAMPLER was lowered to the bottom of each well. The sampling mechanism was then activated to collect an insitu groundwater sample. The sample bottles were examined in the field. No visible DNAPLS were seen in any of the samples, and no noticable odor was detected.

3.6.1.2 Groundwater Inorganics Results

The most abundant metals detected in the groundwater are calcium, sodium, magnesium and potassium, in order of decreasing abundance. These metals are commonly the most abundant metals in natural groundwater. No trends in the groundwater data were observed that would suggest metals contamination.

All metals are below applicable federal standards for drinking water. Manganese and iron, however, were above secondary guidelines. Manganese, is detected above the Federal limit of 50 ppb in every groundwater sample. Because manganese is elevated in all wells, both on and off-site, it is likely that the elevated manganese concentrations are a natural phenomenon.

Iron concentrations are elevated in some wells, but are probably indicative of natural conditions since iron is such an abundant metal in on-site soils. Ohio Water Service Inc (OWS) also reported high Fe concentrations on their OWS water production wells near the site. Concentrations were reported to range between 0.5 and 1.5 ppm.

3.6.2 Surface Water

The results of the surface water sampling are tabulated in Appendix D. Surface water in Newman Creek was sampled at three locations, an upstream sample (SW-5), an adjacent sample (SW-4), and a downstream (plant outflow) sample (SW-1). These samples were analyzed for VOCs and inorganics.

3.6.2.1 Surface Water VOC Results

The VOC analytical results from the surface water sampling (Figure 3-12) indicated the presence of four compounds. These were methylene chloride acetone, 1,1,1-TCA, and TCE. Methylene chloride was present at equal concentrations in all three samples (SW-1, SW-4, SW-5) and was present in associated blank samples. The presence of methylene chloride was probably a result of laboratory procedures.

The other two compounds (1,2-DCE, 1,1,1-TCA, TCE) were only detected in the plant outflow sample (SW-1). The results of SW-1 indicated the presence of 11.0 ppb of 1,1,1-TCA, and 33.0 ppb of TCE. These two compounds were detected in higher concentrations in the production/recovery wells W-1 and W-10 on the site. The discharge from these wells is used for cooling and cleaning on the site, then pumped through the air stripper,

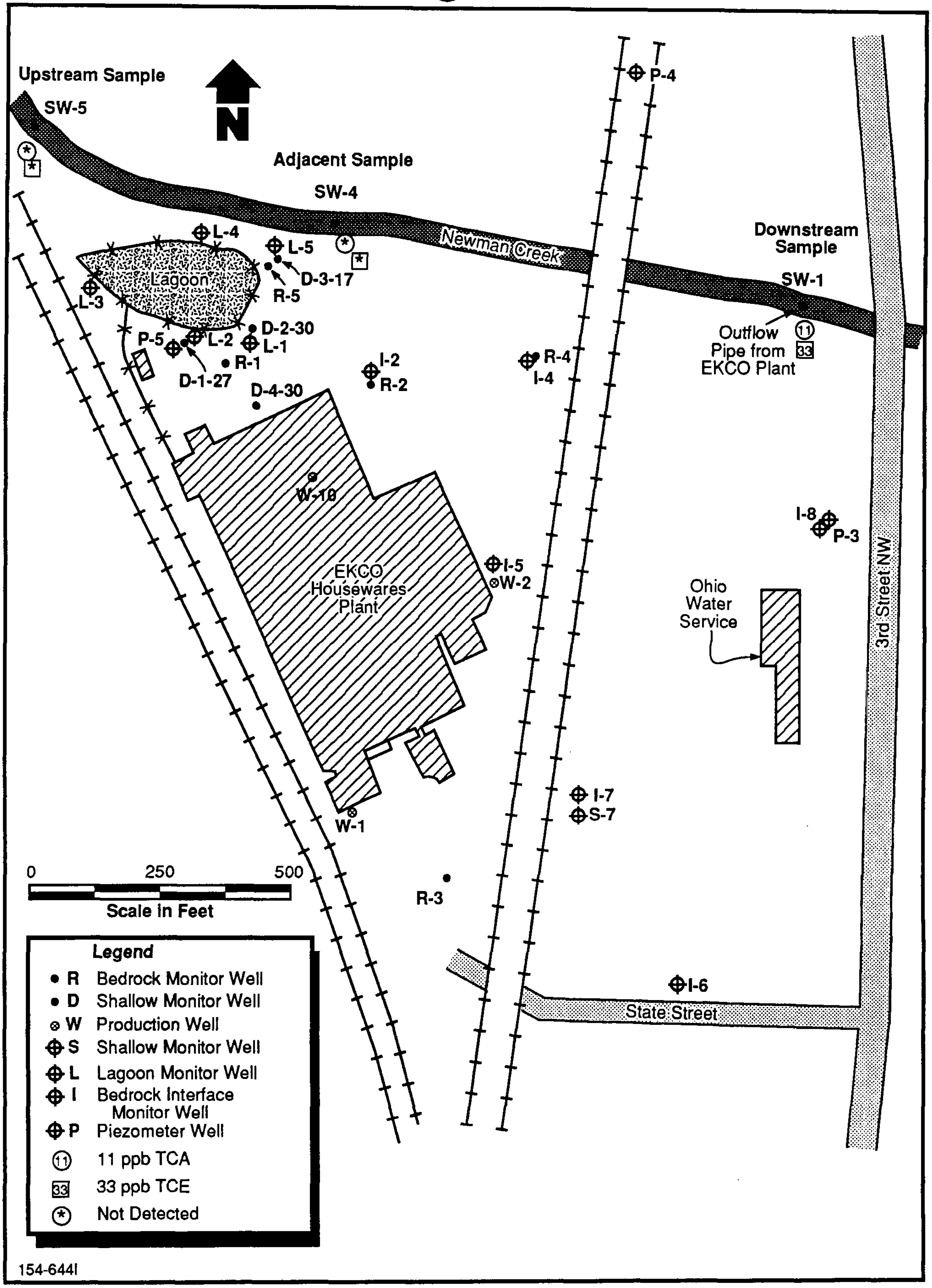


FIGURE 3-12 SURFACE WATER VOC RESULTS

and then discharged into Newman Creek. The presence of these compounds in the plant discharge sample is believed to be due to flow of storm water into the discharge pipe. Storm water enters the pipe through a series of grates in and around the plant building. Storm water could contact contaminated soil prior to entering the pipe. A remote camera survey of the pipe was performed and no breaks were identified. The total VOC discharge into the creek is 72 ppb, which is below the maximum of 200 ppb imposed by the Ohio EPA.

3.6.2.2 Surface Water Inorganics Results

The surface water analytical results indicated that all metals are below applicable federal standards for drinking water, iron and maganese, however, were above secondary guidelines for safe drinking water. The Federal secondary guidelines for iron and manganese are 300 ppb and 50 ppb respectively.

The upstream sample (SW-5) and the adjacent sample (SW-4) had iron concentrations of 563 ppb and 586 ppb respectively. Since the upstream sample (SW-5) is only very slightly lower than the adjacent sample (SW-4), there is probably a high natural concentration of iron in Newmans Creek. The plant outflow sample (SW-1) had a much lower iron concentration of only 72.0B ppb (B = present in field blank), indicating lower concentrations of iron in groundwater. The high results are probably attributable to suspended solids in the unfiltered surface water samples.

The upstream sample (SW-5) and the adjacent sample (SW-4) had manganese concentrations of 96 ppb and 109 ppb respectively, also indicating a high natural concentration of manganese in Newman Creek. The plant outflow sample (SW-1) had a much higher manganese concentration of 536 ppb. High concentrations of manganese were also found on the site in the groundwater. Again, unfiltered suspended solids may be responsible for the high surface water concentrations detected.

3.6.2.3 Surface Water Velocity Measurements

On 15 November, 1988, the stream velocity for Newman Creek was measured at two locations (upstream and downstream). The upstream measurement was taken adjacent to monitoring well L-4, and the downstream velocity was measured 50 feet upstream of 3rd Street bridge.

At the upstream location, the stream was 27 feet wide. The velocity and water depth were measured every two feet across the stream. Velocities ranged from 0.3 to 1.15 feet per second (ft/sec) with an average velocity of 0.81 (ft/sec). The water depth measurements ranged from 0.33 feet to 1.1 feet with an average depth of 0.68 feet.

At the downstream location the stream was 28 feet wide. Velocities ranged from 0.4 (ft/sec) to 1.85 (ft/sec), with an average velocity of 1.26 (ft/sec). The water depth measurement ranged from 0.3 feet to 0.85 feet with an average depth of 0.71 feet. The variation between the upstream and downstream measurements is probably due to the inaccuracy in the measurement method. The results only indicate order of magnitude discharge rates.

3.6.3 Stream Sediments

The results of the stream sediment sampling are tabulated in Appendix D. Sediments were sampled at the base of Newman Creek at five locations. Three of the sample locations (CS-1, CS-4, CS-5) were at the same locations as the surface water samples (SW-1, SW-4, SW-5). The remaining two samples (CS-2, CS-3) were located downstream near sample CS-1. These samples were analyzed for VOCs and inorganics.

3.6.3.1 Stream Sediments VOC Results

The VOC analytical results of the stream sediment sampling (Figure 3-13) indicated the presence of five compounds. These were methylene chloride, acetone, 2-butanone, 1,1,1-TCA, and TCE.

Methlyene chloride and acetone were present in all five samples and also at similar concentrations in associated blank samples. Methylene chloride and acetone are probably the result of laboratory procedures. The 1,1,1-TCA concentration was much higher in the plant discharge sample (CS-1) with a concentration of 10 ppb. The plant discharge sample (CS-1) also contained 66 ppb TCE. The plant discharge water sample also contained elevated levels of TCE and 1,1,1-TCA (33 ppb and 11 ppb respectively). The elevated levels of several VOCs in the sediment sample was probably due to the contact of the sediments with the VOCs in the plant discharge water.

3.6.3.2 Stream Sediments Inorganics Results

The inorganic concentrations reported in four of the five stream sediment samples (CS-2, CS-3, CS-4, CS-5) were relatively consistant, showing only minor changes, with the exception of iron. The iron concentration in the upstream sample (CS-5) (30,000 ug/kg) was higher than any of the other samples (11,000 ug/kg to 18,700 ug/kg).

The plant discharge sediment sample (CS-1) was the only sediment sample which showed a significant difference in inorganic concentrations. This sample showed concentrations of barium, calcium, copper, magnesium, and manganese which were significantly higher than in all the other four samples.

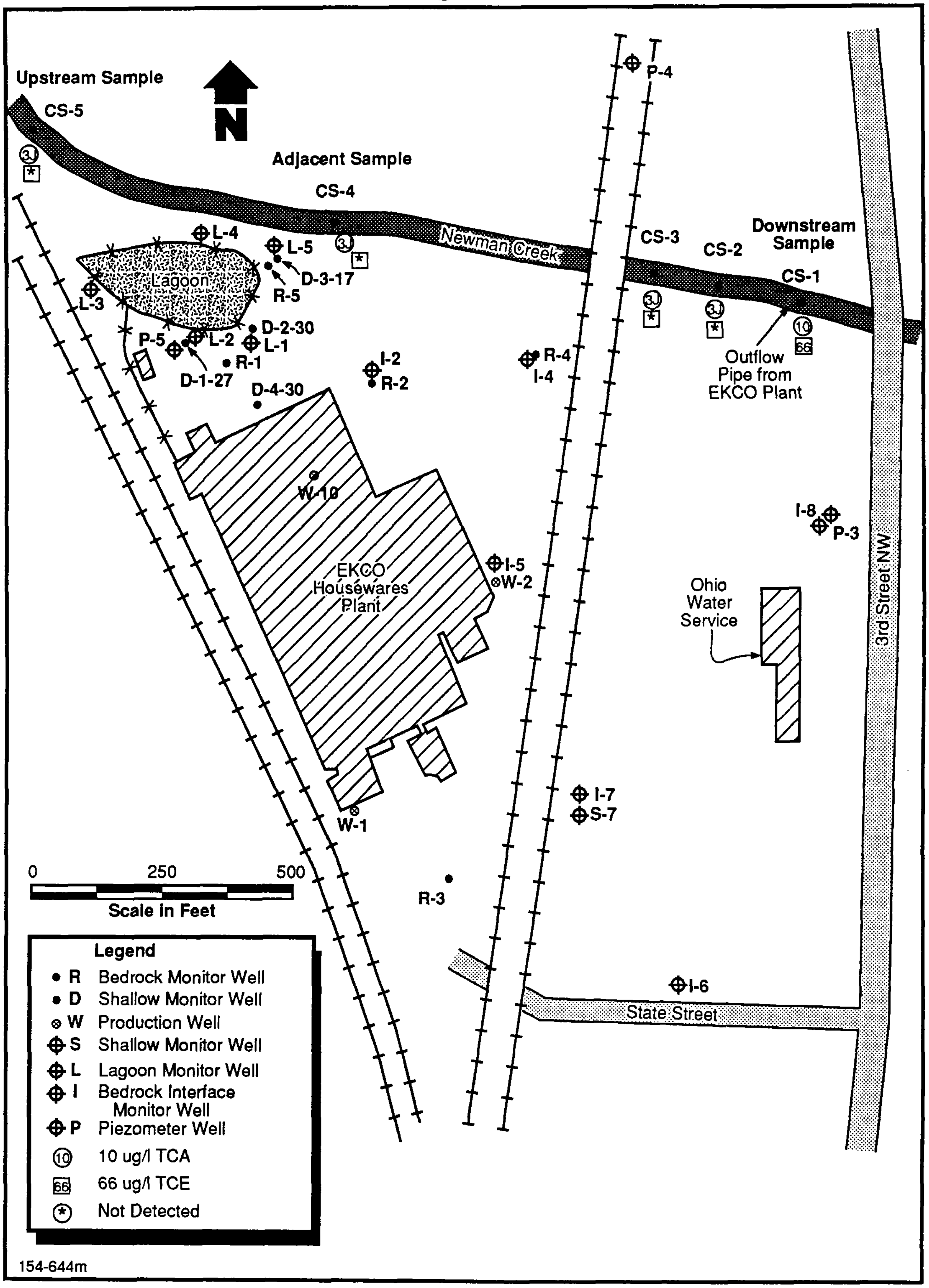


FIGURE 3-13 STREAM SEDIMENT SAMPLES VOC RESULTS

3.7 AQUIFER TESTING RESULTS

During December 1988, a 120 hour recovery/drawdown pumping test was performed to evaluate transmissivity and storativity values as well as to evaluate qualitatively the extent of hydrologic connection between the bedrock aquifer and the overlying saturated unconsolidated sediments. The pumping rate during the drawdown portion of the test was 325 gpm. The results of the pumping test are presented in Table 3-6.

All wells reached near static conditions prior to starting the drawdown test, providing a reliable time-drawdown starting point for transmissivity and storativity calculations. The calculations were done using the Jacob Straight Line time drawdown method.

Data from all five bedrock wells (R-1 through R-5) were analyzed. Transmissivities ranged from 12,000 gallons per day per foot (gpd/ft) (0.018 square ft/sec.) in R-3 to 68,000 gpd/ ft (0.102 square ft./sec.) in R-4, indicating a relatively large degree of variation in transmissivity across the area. Storativities ranged from 0.002 (dimensionless) in R-5 to 0.0001 in R-3. Storativity values for a confined aquifer range from 0.00001 to 0.001 (Driscoll, 1986). The storativity values from this test are within and slightly above (.002) the accepted values for a confined aquifer.

The extent of hydrologic connection between the bedrock and the unconsolidated zones was analyzed by comparing the total drawdown and recoveries in the respective wells. Total drawdown and recovery graphics are presented in Figure 3-14 and Figure 3-15. All five bedrock wells experienced significant drawdown, ranging from two feet to almost 10 feet. This indicates direct connection between the pumping well (W-10) and the bedrock wells.

Table 3-6 lists the total drawdown, total recovery, and the difference between the two for each well during the test. In most wells drawdown was slightly greater than recovery. However in wells R-1, W-10, L-1, L-2, L-3 and L-5 drawdown was slightly less than recovery. Available data is not sufficient to determine the cause of these minor differences, however several possibilities exist. Off-site Ohio Water Service wells less than 2,500 feet away pumping at a relatively high rate may have had minor effects on the water levels on the site. Changes in barometric pressure during the test also may have caused minor changes in water levels. Exceptionally cold weather during the drawdown test caused some minor amount of ice to form in the shallow L-wells, which may have affected water level measurements.

With the exception of I-8, drawdowns in the unconsolidated zone wells ranged from 0.57 to 0.85 feet, indicating connection between the bedrock and unconsolidated zones. Well I-8 experienced virtually no measurable water level change (0.02 ft) throughout the test.

Table 3-6

Aquifer Test Summary, December 1988
Discharge (Q) = 322 gpm

Well	Transmissivity (gpd/ft)	Storativity (dimensionless)	Max. Draw down (ft)	Approx. Distance from Pumping Well (ft)
R-1	16,000	0.001	9.8	260
R-2	39,000	0.001	4.8	210
R-3	12,000	0.0001	8.2	800
R-4	68,000	0.0006	2.0	490
R-5	26,000	0.002	4.5	400

Well	Total Drawdown (ft)	Total Recovery (ft)	Difference (Drawdown - Recovery)
R-1	9.72	9.97	-0.25
R-2	4.67	4.59	0.08
R-3	8.24	8.25	-0.01
R-4	2.19	1.90	0.29
R-5	4.47	4.98	-0.51
W-10	13.61	14.86	-1.25
I-2	0.75	0.67	0.08
I-4	0.85	0.51	0.34
I-5	0.76	0.50	0.26
I-6	0.57	0.33	0.24
I-7	0.73	0.47	0.26
I-8	0.02	-0.08	0.10
L-1	0.03	0.25	-0.22
L-2	0.00	0.08	-0.08
L-3	0.04	0.21	-0.17
L-4	0.08	0.00	0.08
L-5	0.08	0.21	-0.13

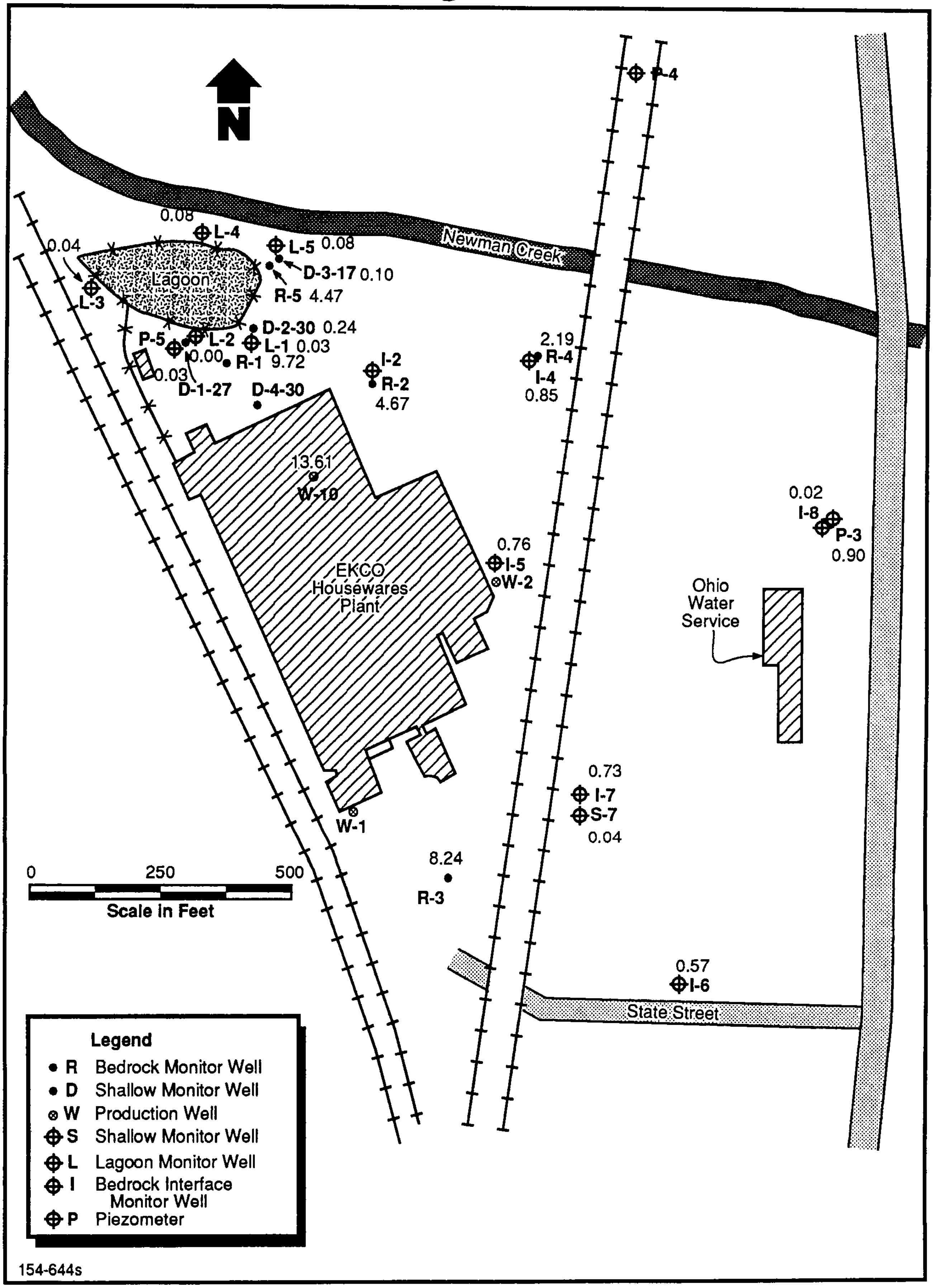


FIGURE 3-14 TOTAL DRAWDOWN DURING AQUIFER TEST (FT.)

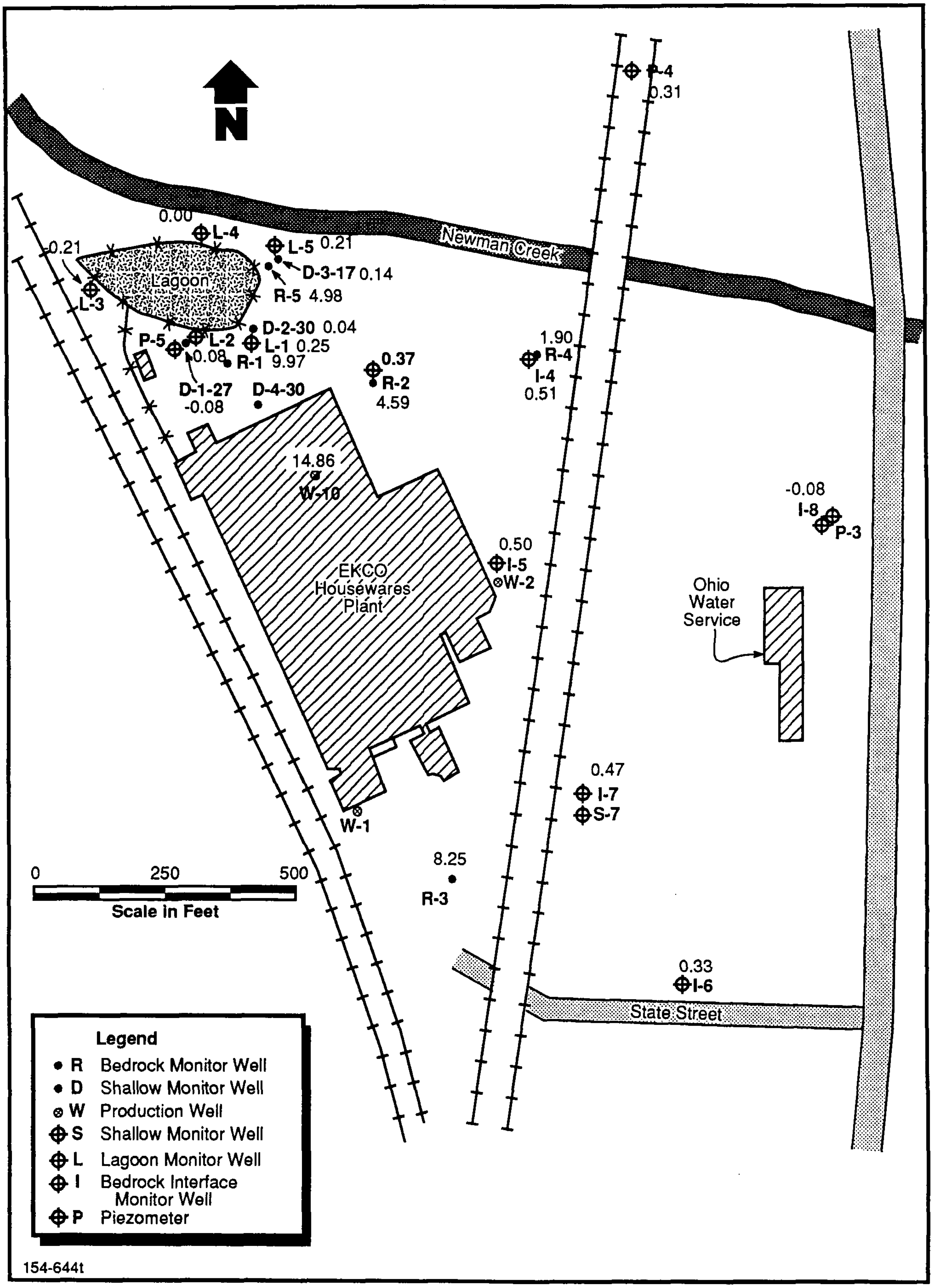


FIGURE 3-15 TOTAL RECOVERY DURING AQUIFER TEST (FT.)

3.8 SITE GEOLOGY AND HYDROGEOLOGY

3.8.1 Site Geology

3.8.1.1 Fill Materials

The EKCO facility has been constructed on top of fill material that ranges up to approximately 25 feet in thickness as shown in Table 3-7. The thickness values in the table represent the estimated thickness of fill material on the site based upon the well logs. The fill, predating the EKCO facility, was used to level the site and covers a large portion of the EKCO property to the north, east, and southeast of the building. The fill is thickest around the lagoon and southeast of the lagoon.

The fill deposits consist of a wide variety of materials ranging from construction debris to fly ash. At the surface, the fill is a very hard compacted material with low permeability. The fill is less compacted with depth. Much of the fill area is used for a parking lot. Natural unconsolidated deposits underlie the fill; based upon current data, fill deposits are not in contact with bedrock.

3.8.1.2 Unconsolidated Deposits

Directly underlying the fill materials is a variable thickness of unconsolidated deposits. The unconsolidated deposits are primarily glacial outwash consisting of medium sands and gravels with some interbedded silts and clays.

As seen in Figures 3-16 and 3-17, the unconsolidated deposits vary in composition both vertically and horizontally. This variation causes significant differences in vertical and horizontal permeability.

The unconsolidated deposits thicken on the site from west to east, ranging in thickness from 4 feet at SB-11 to 150 feet in I-6. To the west (off-site), the unconsolidated deposits become progressively thinner, reaching zero thickness at the bedrock outcrop about 200 feet west of the site. To the east, the deposits thicken toward the Tuscarawas River.

Table 3-7

Thicknesses of Fill Material

Well Number	Fill Material Thickness(a) (feet)
I-2	0-5
I-3	5
I-4	0-5
I-5	17
I-6	7
I-7	7
I-8	0-3.5
L-1	17
L-2	22
L-3	0-3.5
L-4	0-3
L-5	0-7
P-3	0-3.5
P-4	0-3
P-5	22

(a) Fill material thicknesses are based upon interpretation of materials in the drilling logs. Where a thickness range is indicated, an uncertain fill thickness, based upon the log, is present, i.e., 0-5.

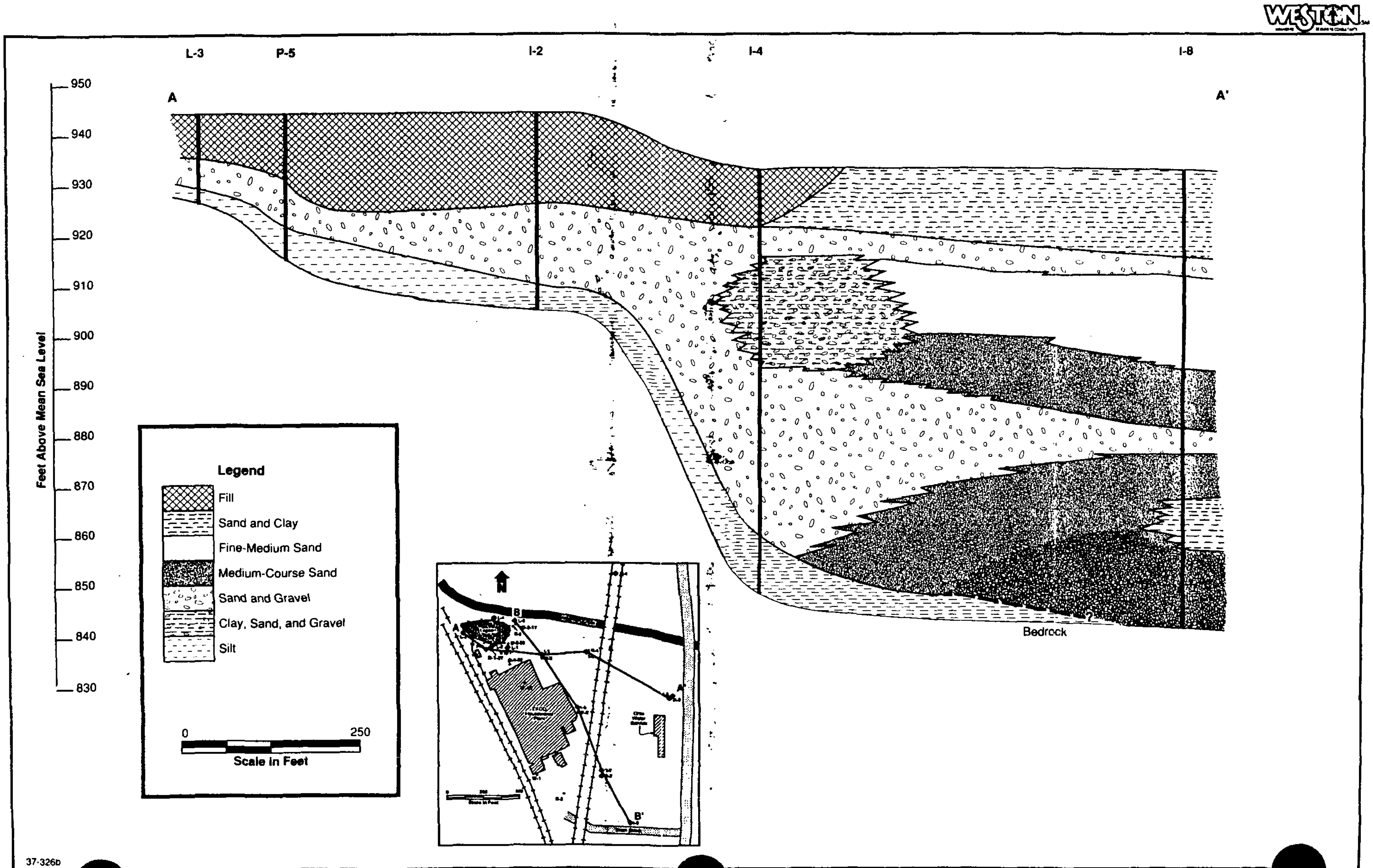


FIGURE 3-16 GEOLOGIC CROSS S[...]N A-A' AT EKCO HOUSEWAR[...] PLANT, MASSILLON, OHIO

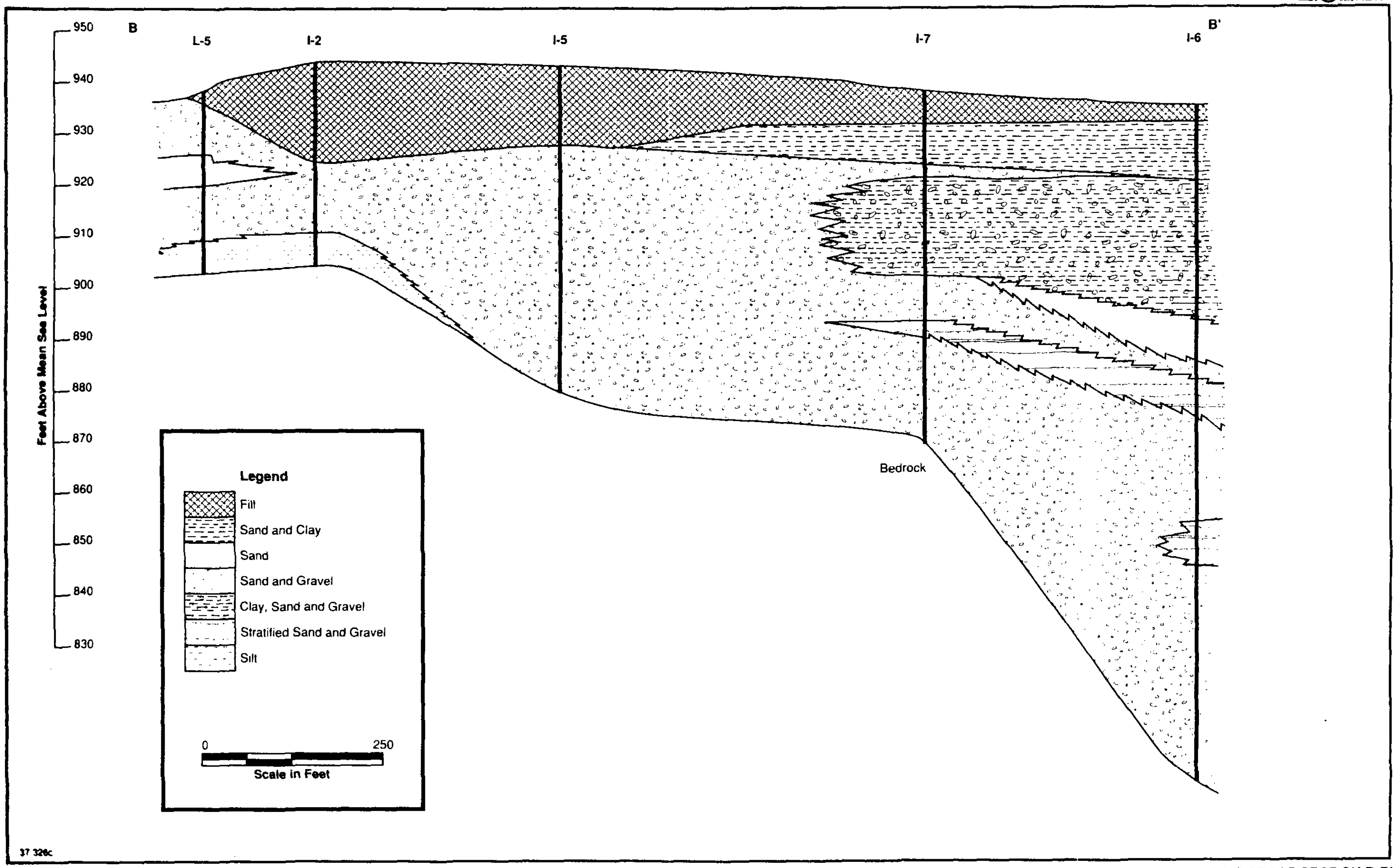


FIGURE 3-17 GEOLOGIC CROSS SECTION B-B' AT EKCO HOUSEWARES PLANT, MASSILON, OHIO

3.8.1.3 Bedrock

Directly underlying the unconsolidated deposits is interbedded sandstone and shale bedrock. The EKCO site lies on a bedrock high (bedrock slopes away in three directions) which slopes to the east and northeast at approximately 16 degrees. The slope of the bedrock surface, based upon boring logs, is graphically represented in the bedrock surface contour map presented as Figure 3-18.

3.8.2 Site Hydrogeology

Site hydrogeologic conditions, based upon the findings of the Phase I and II efforts, are described below. The discussion has been subdivided into the following topics:

- Hydrogeologic system
- Groundwater flow
- Groundwater gradients
- Interface dewatered zone
- Estimated flow rates

3.8.2.1 Hydrogeologic System

For the purposes of this report, the hydrogeologic system at EKCO has been subdivided into three interconnected zones, which are as follows: the fill, the unconsolidated glacial deposits, and the bedrock zones. Each of these zones has unique hydraulic properties, and each is affected by the EKCO and Ohio Water Service (OWS) pumping in different ways and to a different extent.

As mentioned in Section 3.8.1, a large portion of the EKCO site is covered with up to 25 feet of fill material. The fill has a significant effect on groundwater flow at the site. Based upon available soil borings and well logs, the fill consists of a variety of fine-grained materials (such as fly ash), which typically have relatively low permeability, being restrictive to both vertical and horizontal groundwater flow. Most of the fill is highly compacted, further inhibiting the movement of groundwater.

Water levels in the fill and native silt material (L-wells) were higher and had a steeper gradient toward the recovery well W-10 than did water levels in the sand and gravel (I-wells). The water levels in the L-wells and I-wells are probably responding differently to W-10 pumping due to differences in aquifer permeability and screen elevation. The L-wells are screened in much lower permeable material and at higher elevations than the I-wells.

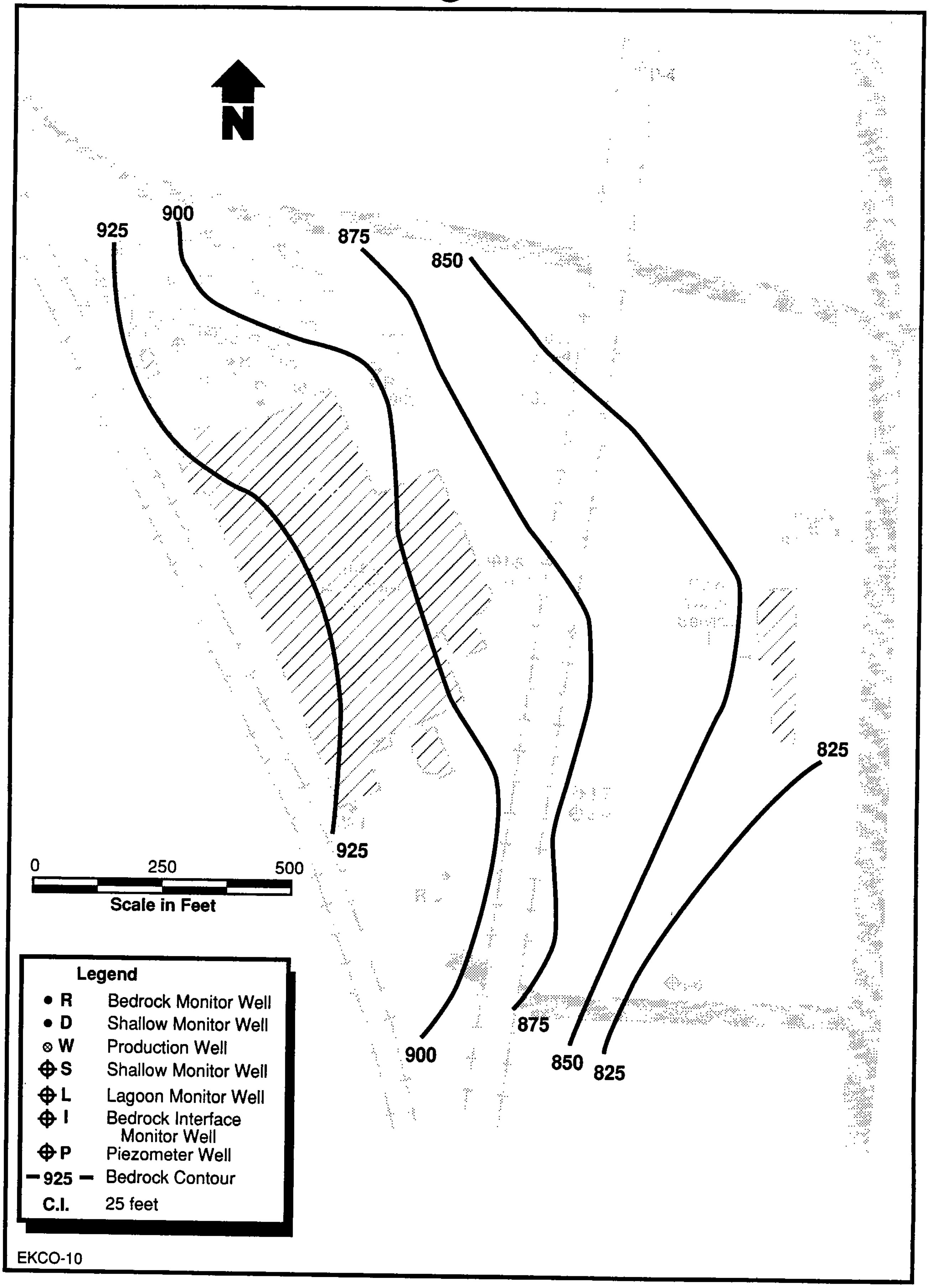


FIGURE 3-18 BEDROCK SURFACE CONTOUR MAP

The depth to water varies significantly in the five lagoon wells. The depth to water ranges from a low of 8.57 feet in L-4 to a high of 25.49 feet in L-1. The saturated thickness in the lagoon area also varies significantly, due to changes in water elevations and considerable changes in bedrock elevation. Saturated thicknesses range from less than one foot in L-3 to 37.3 feet in L-5.

Based on available well logs and soil borings, the entire EKCO property is underlain by unconsolidated glacial deposits. These deposits thicken from west to east, extending from about 200 feet west of the site, to past the Tuscarawas River, 2000 feet east of the site. The deposits are relatively thin south of the plant (in the parking lot area), with an average thickness of about 31 feet.

Because of the interbedded silts and clays, the glacial deposits exhibit permeability which varies both horizontally and vertically. Despite this heterogeneity, the glacial deposits as a whole represent a very productive aquifer. For example, OWS production wells are completed within these deposits; records indicate single-well yields of up to 2800gpm less than one half mile north of the EKCO facility. The depth to water varies approximately 13 feet in the five interface wells. Values vary from a high of 35.0 feet in I-2 to a low of 22.0 feet in I-4. The saturated thickness varies significantly in these wells, ranging from only 7.0 feet in I-2 to 103.2 feet in I-6.

The bedrock zone, directly underlying the unconsolidated zone, underlies the entire EKCO plant at varying depths, ranging from 4 feet to the west to 130 feet to the east at the site. Since no site wells have been drilled through the entire productive zone within the bedrock, the total saturated thickness is unknown. However, at least 200 feet of saturated rock exists locally, as W-1 was drilled 200 feet into the bedrock, with saturated conditions reportedly existing at the bottom of the borehole (based upon the drillers record).

The bedrock zone is composed of interbedded layers of sandstone and shale. Available well logs indicate that the shale layers are discontinuous from well to well. As shales are typically less permeable than sandstone, shales may locally separate flow. Such local separation of flow was supported by the aquifer test data, as similarly constructed bedrock wells in different areas responded differently, yielding a wide range of calculated transmissivities and storativities. Calculated values for transmissivity and storativity in the bedrock zone ranged from 12,000 gpd/foot and 0.0001 to 68,000 gpd/foot and 0.002, respectively. These storativity values lie midway between those of a confined and an unconfined aquifer, indicating a partially confined aquifer in the area of the pumping well.

3.8.2.2 Groundwater Flow

Groundwater flow within the three zones at the EKCO site (see above) is discussed in this subsection. Each of the three zones has significantly different hydrologic properties (as described above), and therefore significantly different groundwater flow patterns.

As noted previously, the fill material is thickest north of the plant near the lagoon. Around this area also exists a considerable amount of native fine-grained silt and clay. There are five wells (L-1 through L-5) in this area which were used to evaluate the groundwater flow in the fill. The wells were located in a relatively small area (around the lagoon) to serve primarily as RCRA compliance wells for the lagoon. Due to the lack of additional reliable shallow fill wells on the site, mapping the flow in this zone was restricted to the five lagoon wells.

Figure 3-19 is a groundwater contour map utilizing water levels measured 10 August 1988 in the five lagoon wells. Immediately north of these wells is Newman Creek which flows to the east. Quite often in this type of environment, with a shallow water table system adjacent to a stream, groundwater flow is toward the stream. However, in this case, as can be seen in Figure 3-19, groundwater flow is away from the creek and toward the EKCO plant. This may be due to the continuous pumping of the EKCO recovery wells. There is a fairly substantial head loss (7.36 feet) from L-4 to L-1, indicating a significant horizontal gradient toward L-1. These data suggest that shallow contaminated groundwater in the area of the lagoon, at the screened interval of the five lagoon wells, is likely traveling toward the site and is controlled by the EKCO recovery system. This flow direction has been confirmed in numerous measurements over an 18 month period.

Six interface wells, (I-2, I-4, I-5, I-6, I-7, I-8) were used to evaluate groundwater flow in the unconsolidated zone. These wells were screened at the bottom of the unconsolidated material at the unconsolidated/bedrock interface.

Figure 3-20 is a groundwater contour map utilizing water levels measured 10 August 1988 in the six interface wells and piezometer P-3. The contours suggest drawdown in the plant area toward the recovery wells, and, north of the plant area, toward the OWS wellfield. The divide between the two slopes may correspond with (and be enhanced by) percolation out of Newman Creek. Additional data to be obtained during the proposed RFI/CMS activities will allow more detailed evaluation of groundwater flow in the unconsolidated zone.

Seven wells were used to evaluate the bedrock groundwater flow, including five observation wells (R-1 through R-5), and two recovery wells (W-1 and W-10). These wells are cased to bedrock and then completed as open hole wells into the bedrock.

Figure 3-21 is a groundwater contour map utilizing water levels measured 10 August 1988 in the seven bedrock wells listed above. The overall appearance of the map indicates a deep cone of depression in the bedrock zone under the entire site. Bedrock groundwater flow at the site appears to be toward the recovery wells (W-1 and W-10) from all directions, with a relatively steep gradient. As was noted in Section 1.5.3.7 prior to 1988 the pumping rates at EKCO were less therefore, the area

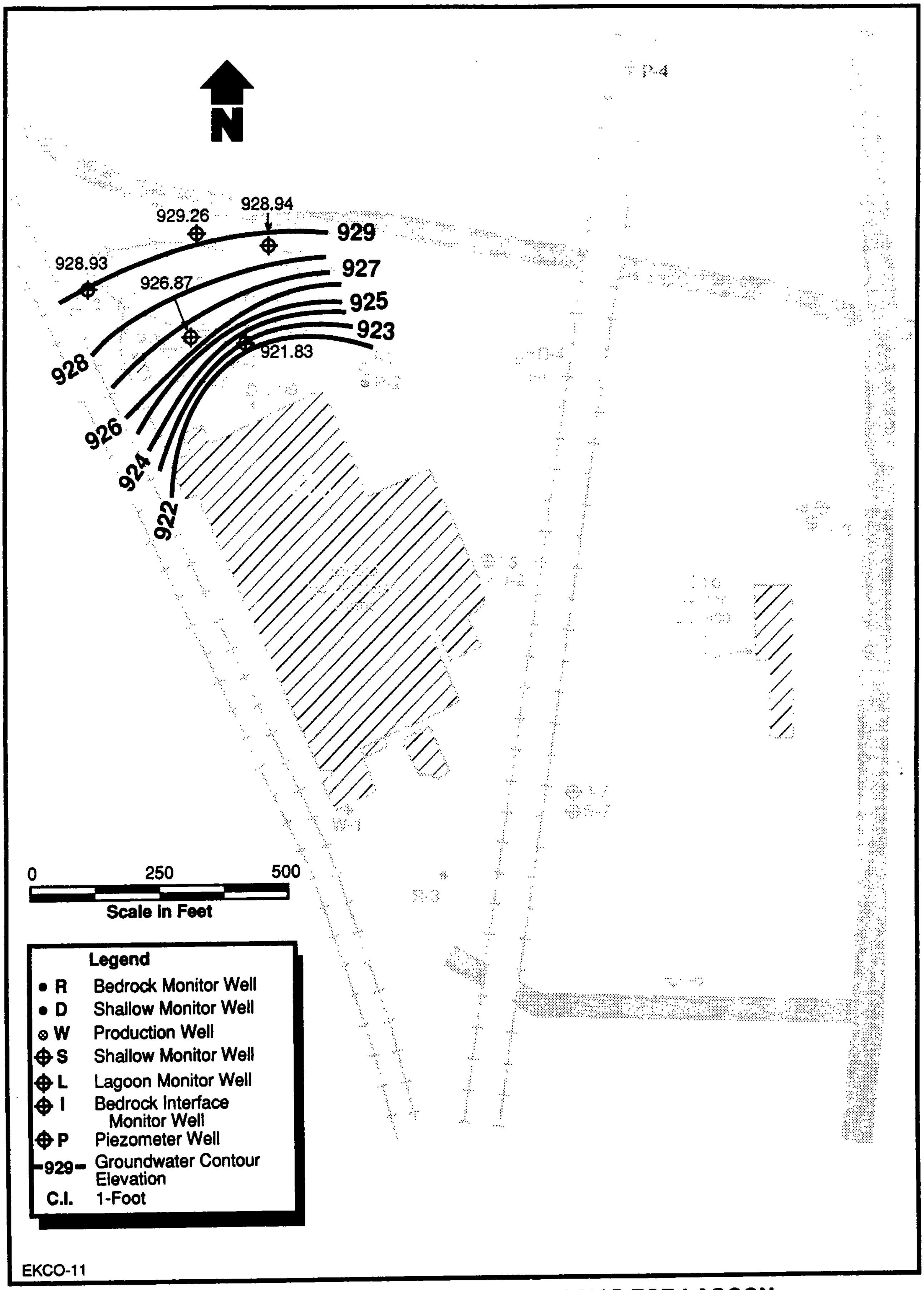


FIGURE 3-19 GROUNDWATER CONTOUR MAP FOR LAGOON WELLS. WATER LEVES MEASURED 8-10-88.

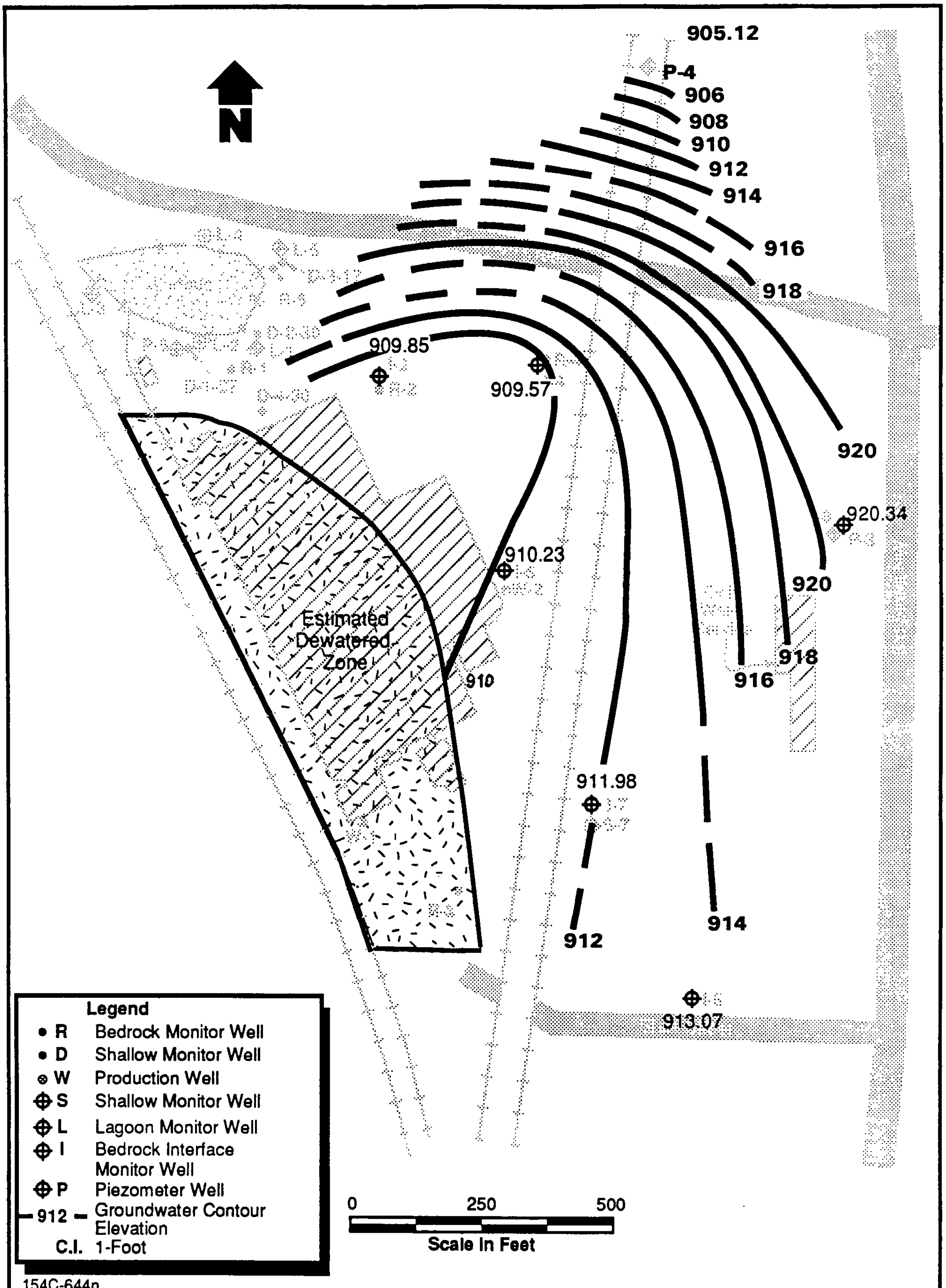


FIGURE 3-20 GROUNDWATER CONTOUR MAP FOR INTERFACE

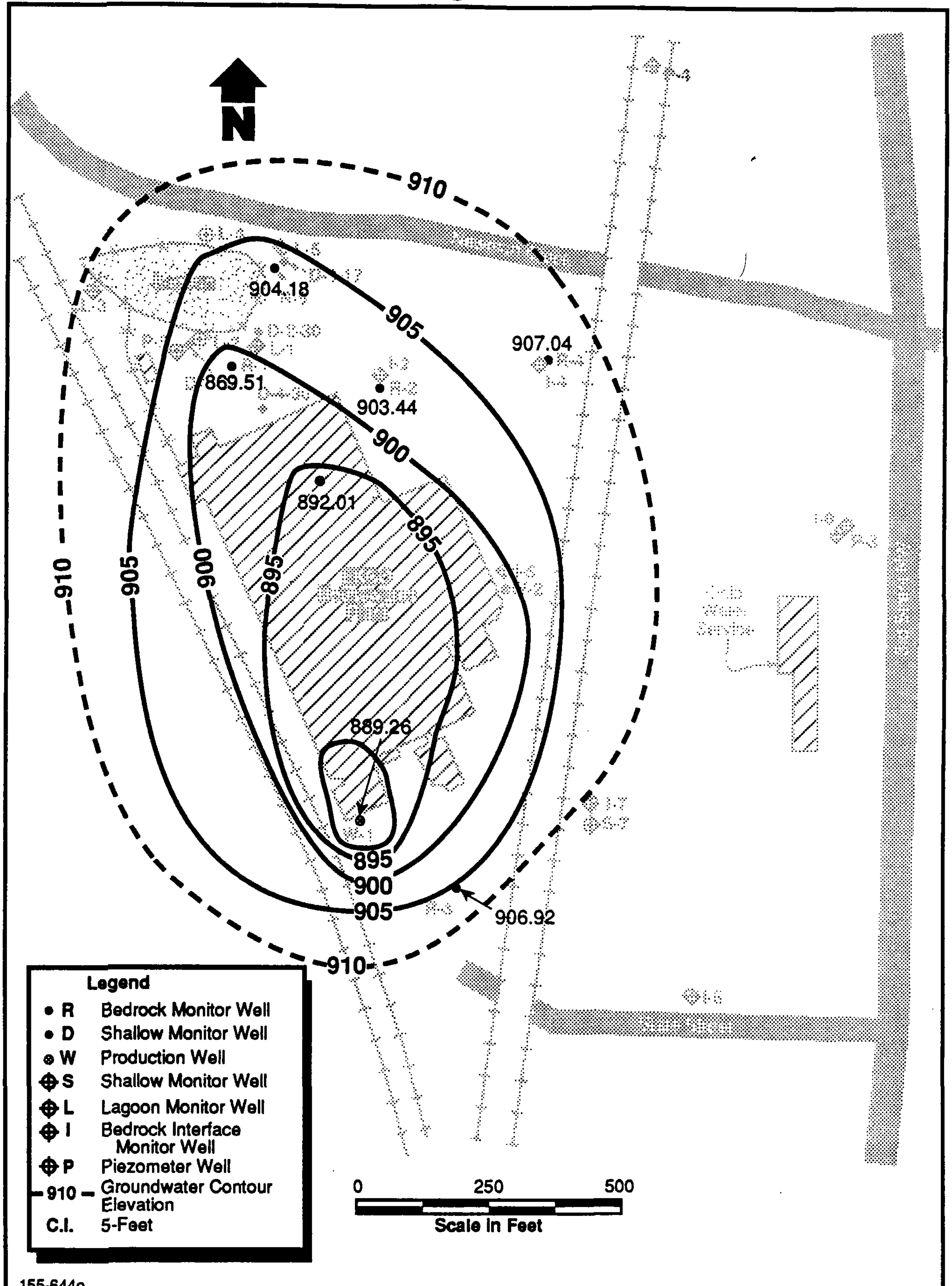


FIGURE 3-21 GROUNDWATER CONTOUR MAP FOR BEDROCK WELLS. WATER LEVELS MEASURED 8-10-88.

of influence around W-1 and W-10 would have been less. Groundwater gradients are discussed in more detail in the following section.

3.8.2.3 Groundwater Gradients

Horizontal groundwater gradients were calculated for all three zones identified at the EKCO site. All gradients are affected by pumping and hence do not reflect native conditions. However, using the best available data, flow rates under actual conditions can be estimated. Horizontal gradients were calculated for each zone by measuring head loss between two wells and dividing by horizontal distance. The vertical gradient between the unconsolidated glacial material and the bedrock was calculated at two locations (R-2, I-2 and R-4, I-4). Vertical gradients were calculated by dividing the amount of head loss in two adjacent wells over the screen elevation difference in those same two wells. In both cases, a higher positive number indicates a steeper downward gradient. All water levels used in these calculations were measured 10 August 1988 during continuous pumping at EKCO recovery wells W-1 and W-10.

As can be seen from the countour map (Figure 3-19) the horizontal gradient in the fill materials varies across this area. The northern section has an average gradient of .030-feet/foot. The southern section has a steeper average gradient of 0.047-feet/foot. The steeper gradient to the south may be the result of the hydraulic influence of the pumping of well W-10.

The primary gradient in the unconsolidated zone is believed to be toward the north, with a local component toward the primary recovery well (W-10). The average horizontal gradient calculated for this zone was 0.025 feet/foot. This gradient is roughly one half as steep as that of the fill zone near the lagoon.

The bedrock horizontal groundwater gradient varied somewhat due to varying transmissivities. The average gradient was 0.04-feet/foot, roughly similar to the gradient in the fill near the lagoon and much higher than the unconsolidated layer.

The vertical gradients between the unconsolidated glacial material and the bedrock was calculated at two well pair locations (R-2, I-2 and R-4, I-4). This gradient was downward at both locations mainly due to the pumping influence of wells W-1 and W-10. The vertical gradient from the screen in I-2 (unconsolidated zone) to the bedrock R-2 was 1.07-feet/foot. This indicates a steep downward gradient from the unconsolidated zone to the bedrock at this location. The vertical gradient calculated from I-4 to R-4 was 0.13-feet/foot which is a much less steep gradient. This would be expected since R-4 and I-4 are farther away from the pumping influence of W-10 than is R-2 and I-2.

The combined pumping of W-10 and W-1 are at least part of the cause of the dewatered zone in the southwest corner of the site. This dewatered zone is discussed further in the next section.

3.8.2.4 Interface Dewatered Zone

A boring for the proposed interface well, I-3, was drilled to bedrock next to R-3 south of the plant. No water was encountered. All soil borings drilled along the western side of the plant were drilled to bedrock; water was also not encountered in the unconsolidated zone at these locations. Where the water table intersects bedrock (estimated based upon nearby water elevations and bedrock depths) defines the eastern edge of the "dewatered zone". These data indicate that the unconsolidated material in this area has been dewatered due to present pumping conditions (Figure 3-20). The lack of groundwater in this zone would greatly limit the migration of contaminants in this area.

3.8.2.5 Estimated Rates of Groundwater Flow

Applying Darcy's Law (V = KI/n), a representative groundwater flow rate in the fill material can be estimated. Because groundwater gradients are affected by pumping throughout the Tuscarawas River Valley, gradients used in flow rate estimation reflect these artificial influences. These gradients are the best available data. Assuming:

Hydraulic Conductivity (K) = 0.1 gpd/sq ft
Effective Porosity (n) = 0.15

And using the calculated gradient (I) in the lagoon area of 0.039 ft/ft, the estimated groundwater velocity (v) in the fill is 0.0035 ft/day.

Again applying Darcy's Law, (V = KI/n) the rate of groundwater flow in the unconsolidated sand and gravel can be estimated. Assuming:

Hydraulic Conductivity (K) = 400 gpd/sq ft
Effective Porosity (n) = 0.25

And using the calculated gradient (I) across the facility of 0.003 ft./ft., the estimated groundwater velocity in the unconsolidated sand and gravel is 0.64 ft/day. As coarser deposits have been recognized east of the facility (along the axis of the valley, coarser deposits and higher hydraulic conductivity would be expected), the rate of groundwater flow is probably higher.

Similarly, applying Darcy's Law (V = KI/n), the rate of groundwater flow in the bedrock can be estimated. Assuming an effective porosity of 0.10, and using a hydraulic conductivity of 128 gpd/sq ft (K = transmissivity divided by saturated thickness, = 32,000 gpd/ft divided by 130 ft), and the calculated gradient (I) across the facility of 0.04 ft/ft, the estimated groundwater velocity in the bedrock is 13.15 ft/day.

SECTION 4

MODELING

4.1 MODEL OBJECTIVES

Groundwater flow modeling was performed as part of the investigation to evaluate present remedial activities and to aid in selection of future investigative and/or remedial activities.

4.2 MODEL SELECTION AND SETUP

The computer code used for this assignment is the "Modular Three-Dimensional Finite-Difference Groundwater Flow Model" (MODFLOW) developed by the U.S. Geological Survey. MODFLOW is a thoroughly documented, numerical model capable of simulating groundwater flow in three dimensions. The model incorporates all the important variable hydrologic features of a complex flow system including boundary and initial conditions, multiple layers, irregular geometry, anisotropy, recharge, pumping wells and rivers.

A model grid was set up consisting of 17 columns and 24 rows, with an average node size of 150 by 150 feet. The model grid covers the entire area of the site, and extends to the north and the east to include the pumping influences of the Ohio Water Service Wells OWS-1, 2, 3, and 4. This model used a two layer system, the overlying saturated unconsolidated aquifer zone designated as an unconfined aquifer called model layer one, and the underlying bedrock zone designated as a partially confined aquifer called model layer two.

4.2.1 Boundary Conditions

Boundary conditions are set up in numerical models to simulate influencing conditions located adjacent to and outside the model boundaries. The two types of boundary conditions used in the model were constant head nodes and active nodes. Constant head nodes are nodes which represent areas of the aquifer where the head will not significantly change with time. The head remains constant and the resulting rate of flow into or out of the designated constant head cell equals the flow required to maintain the head in the aquifer at the specified constant head. Active nodes are nodes which represent areas of the aquifer where the head may change significantly with time.

All the boundary nodes in the layer 2 and the boundary nodes in the southern end of layer 1 were specified as constant head nodes. This was done to maintain the actual head values which are occurring as a result of regional groundwater flow into the grid area. All internal nodes were specified as active nodes.

4.2.2 Assumptions and Limitations

Due to the extreme complexities involved in any aquifer analysis, numerical models are inherently based on a set of assumptions which limit their application. Most importantly, the interpretation of the model results must not exceed the limits of the data on which the model is based. The following assumptions have been made in the development of this groundwater flow model:

- Darcy's law is valid; therefore the only significant driving mechanisms for fluid flow are hydraulic head gradients.
- Vertical variations in hydraulic head are negligible within each layer.
- Input parameters of hydraulic conductivity and transmissivity are constant and equal to the average values assigned to each zone. (Section 4.3.1).
- The aquifer is homogeneous within each given block of the finite-difference grid.

4.3 CALIBRATION

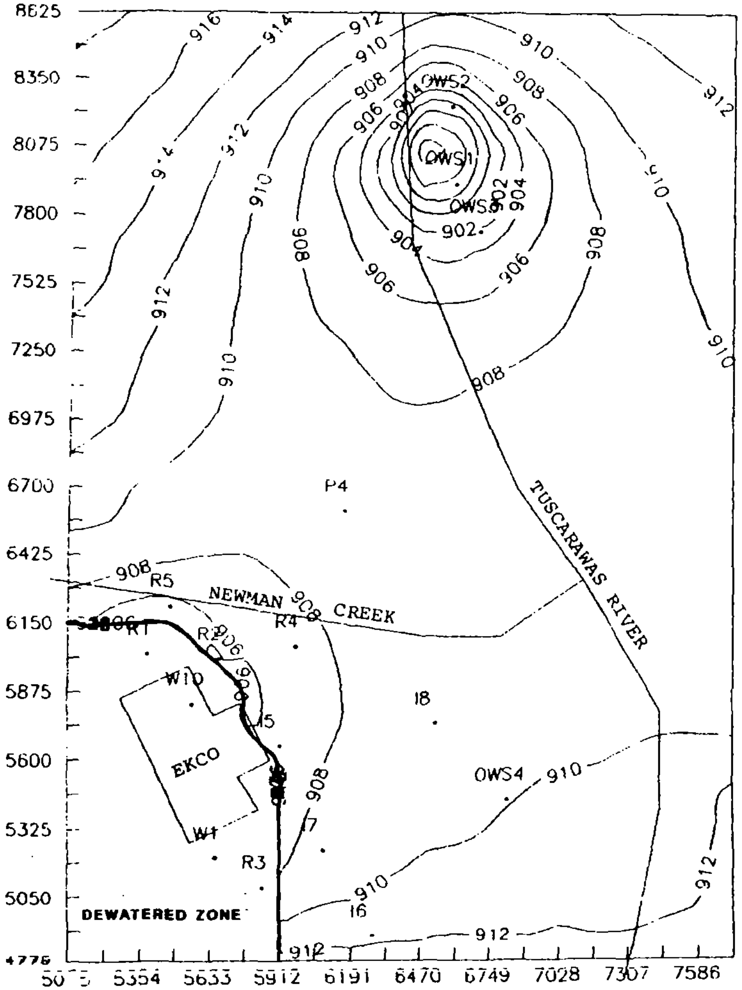
For steady-state calibration, simulated water levels were compared with the observed water levels from 14 observation wells within the model area. The absolute values of the differences in water levels between observed and simulated values were compared after each calibration run. For calibration purposes, water levels measured in November 1988 were applied.

The goal of calibration is to reduce the difference between observed and simulated heads as much as possible. This is done by adjusting input parameters, such as hydraulic conductivities, transmissivities and bedrock top elevations. Figures 4-1 and 4-2 are the final calibration output groundwater contour maps for layer 1 and layer 2, respectively.

The final calibration had an average head difference from the November 1988 water levels of less than 1.5 feet. The only well that showed a considerable difference was P-4, which has a head difference of 2.99 feet. The reason for the deviation is not known at this time, but it may be due to a significant difference between the conceptual model and actual conditions around P-4, since little data is available in this area, (input parameters had to be estimated).

4.4 INPUT PARAMETERS

Transmissivity values used for the bedrock layer in the model were derived from the 120 hour recovery/drawdown pump test conducted at the site in December 1988. The transmissivity in the



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335

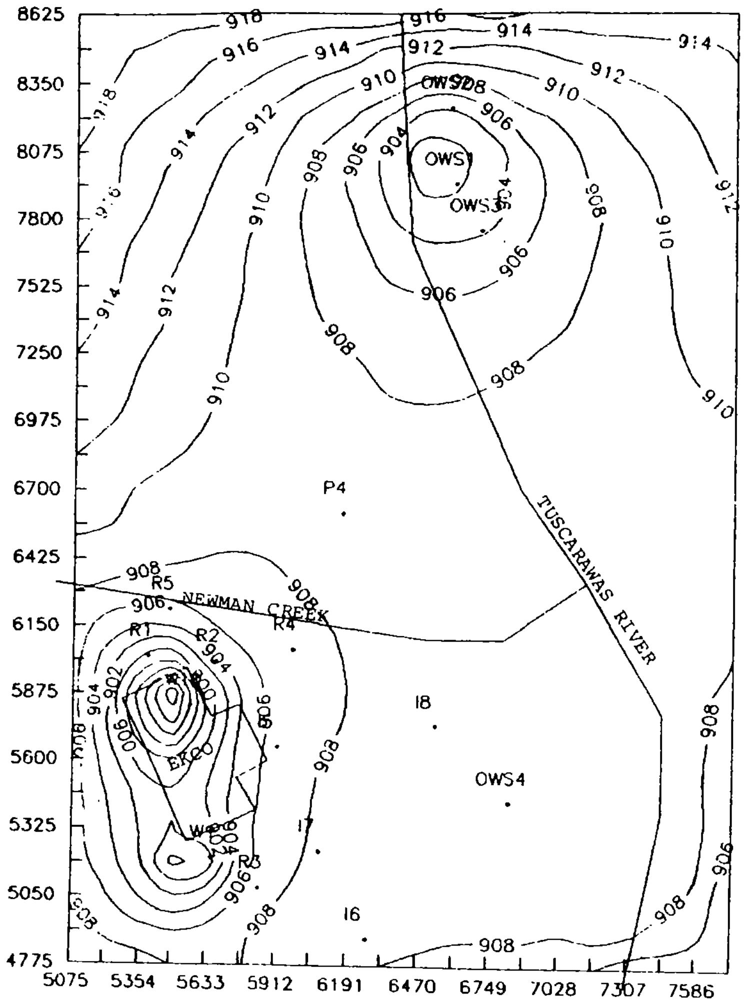
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-1 CALIBRATED EKCO MODEL, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335

SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-2 CALIBRATED EKCO MODEL, LAYER 2 bedrock varies significantly at the site. It was crucial to incorporate these values into the model to adequately simulate the actual aquifer conditions. The transmissivity map used for the model is presented in Figure 4-3.

Because a pump test has not been performed within the unconsolidated layer, conductivity values for this layer had to be inferred from published data, well logs, and ongoing analysis of successive model calibration outputs. Based upon available information, the south west corner of the grid area is characterized by finer-grained sediments typical of glacial till. A low conductivity value (1.7E-6 ft/s) was assigned to this area. The remainder of the grid was characterized by coarser-grained sediments typical of glacial outwash. A high conductivity value (8.0E-4 ft/s) was assigned to this area. Although the unconsolidated deposits are thicker near the river than near wells I-6, I-8, and P-4, calibration of the model (taking into account pumping of and pumping water levels in wells OWS-1, -2, and -3) suggests a relatively consistent conductivity (overall) for layer 1 in the area. The conductivity map used for the model is presented in Figure 4-4.

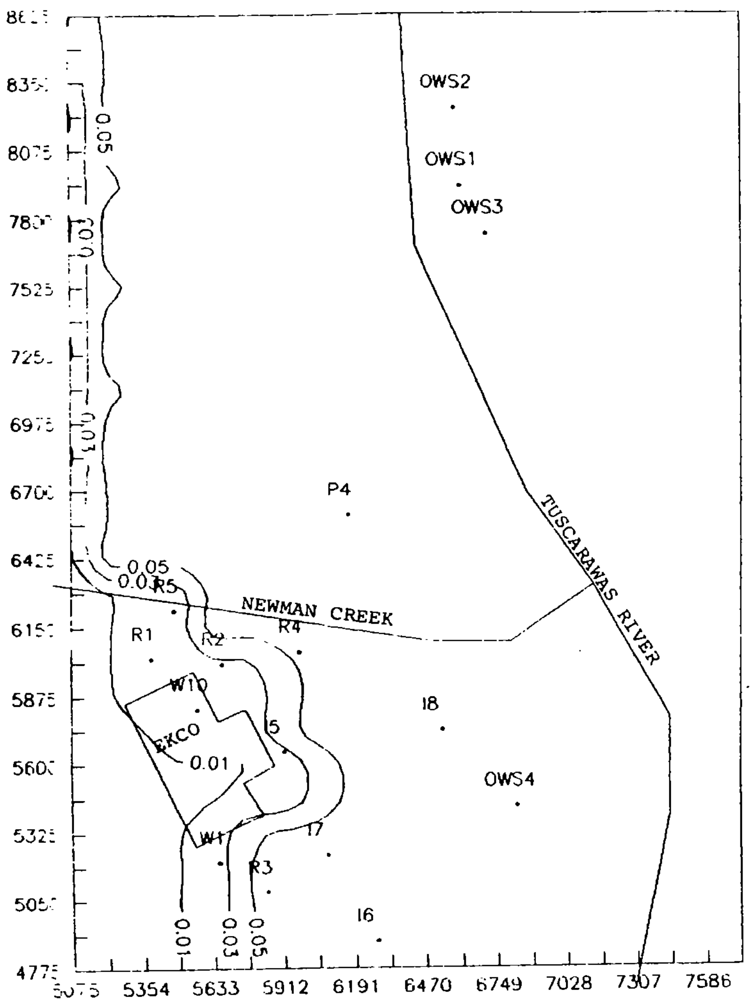
It was necessary to input the bedrock top elevation in order to define the bottom of the overlying unconsolidated layer. A bedrock contour map was derived from wells on the site and then interpolated to the north and east where there are no wells penetrating the bedrock. The bedrock contour map used for the model is presented in Figure 4-5. The thickness of layer 2 was assumed to be constant (sloping parallel to the contours).

As was noted in subsection 3.8.2, available data indicate that the shallow zone near the lagoon consists of a high percentage of fill, with some silt and clay, which significantly affects water levels. Due to the lack of adequate shallow well control away from the lagoon area, it was not possible to incorporate the shallow fill zone into the model as a third layer.

4.5 SIMULATIONS

After the model calibration was complete, five simulations were run (Figures 4-6 through 4-15). During all simulation runs, input parameters were kept the same as the calibrated model. Only the respective pumping rates of the wells concerned were changed.

Simulation No. 1 was run to evaluate the effect on the groundwater system if the EKCO recovery wells were shut down. To accomplish this, the pumping rates of the two EKCO recovery wells (W-1 and W-10) were set equal to zero. Figure 4-6 and Figure 4-7 are groundwater contour maps from this simulation for layers one and two, respectively. Based on the results of this simulation, shutting off the two EKCO recovery wells would cause water levels on the site to rise slightly in layer one



0.05 Transmissivity (ft.^{2}/sec.)

C.I. 0.02 (ft.^{2}/sec.)

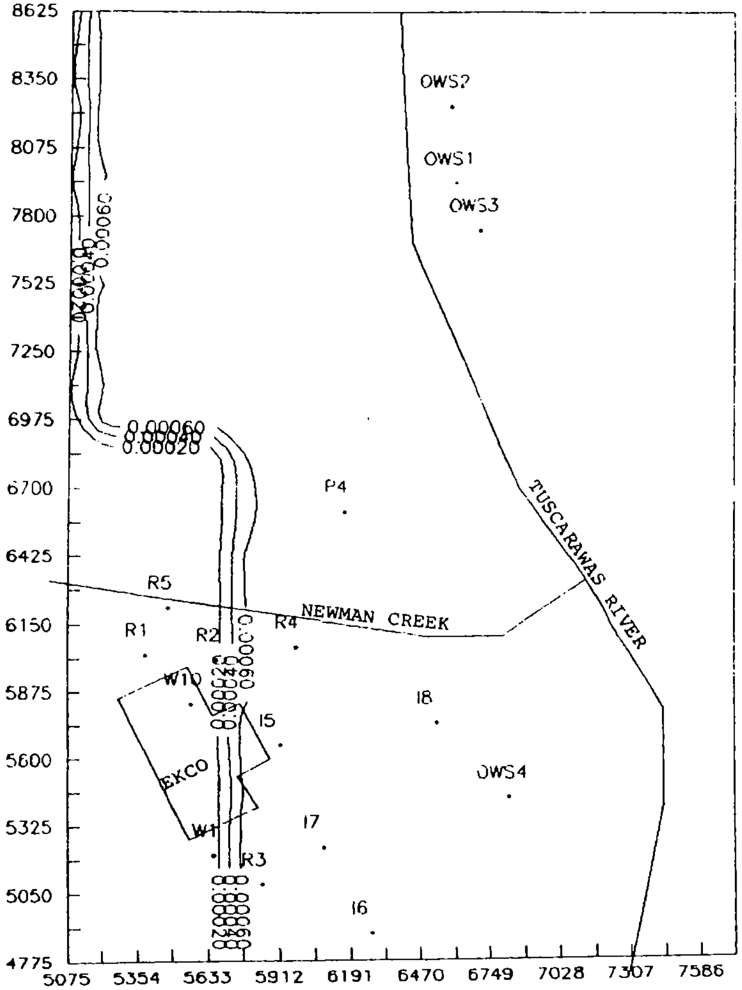
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-3 EKCO MODEL TRANSMISSIVITY MAP, LAYER 2



0.0002 Hydraulic Conductivity (ft./sec.)

C.I. 0.0002 (ft./sec.)

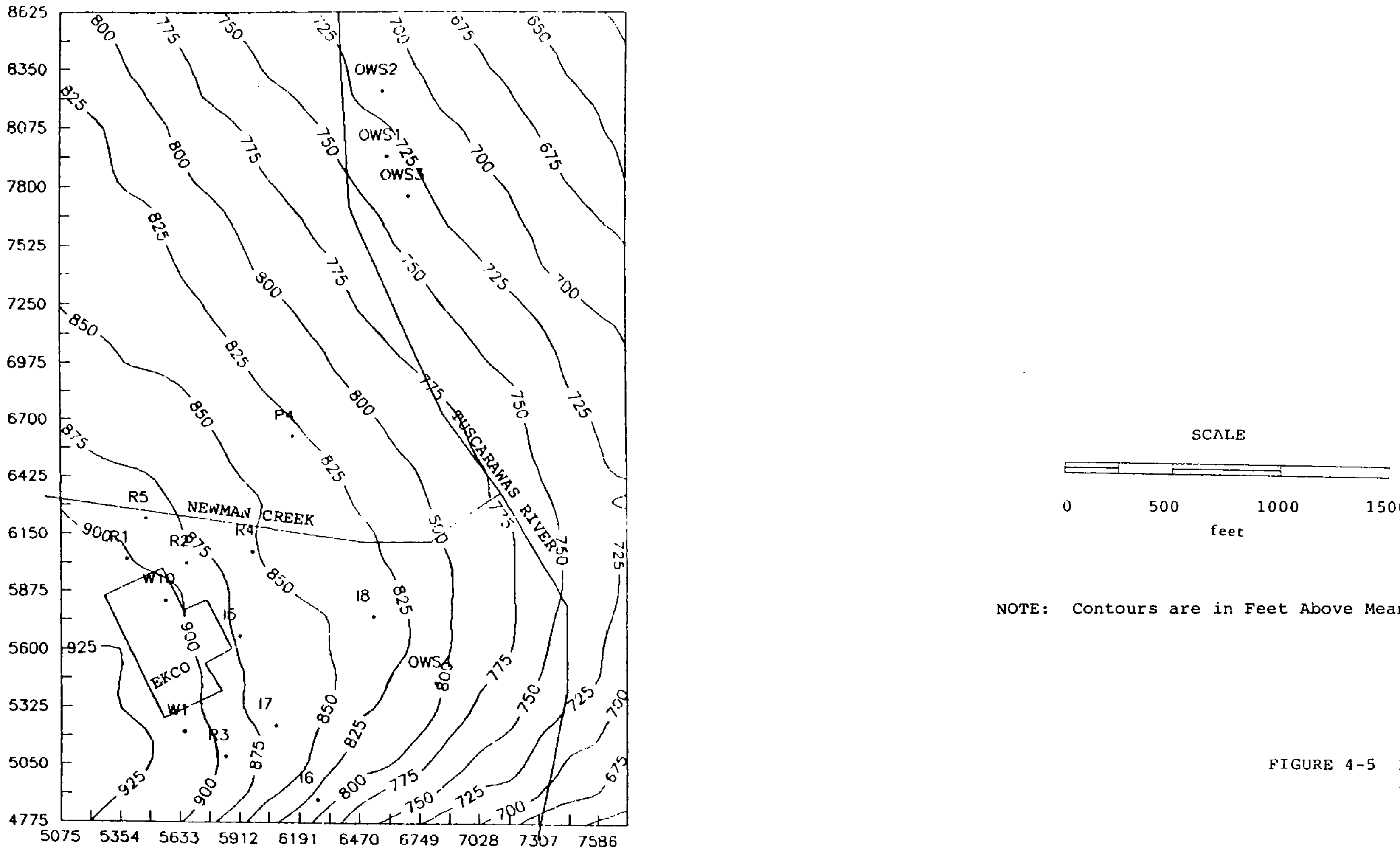
SCALE

0 500 1000 1500

feet

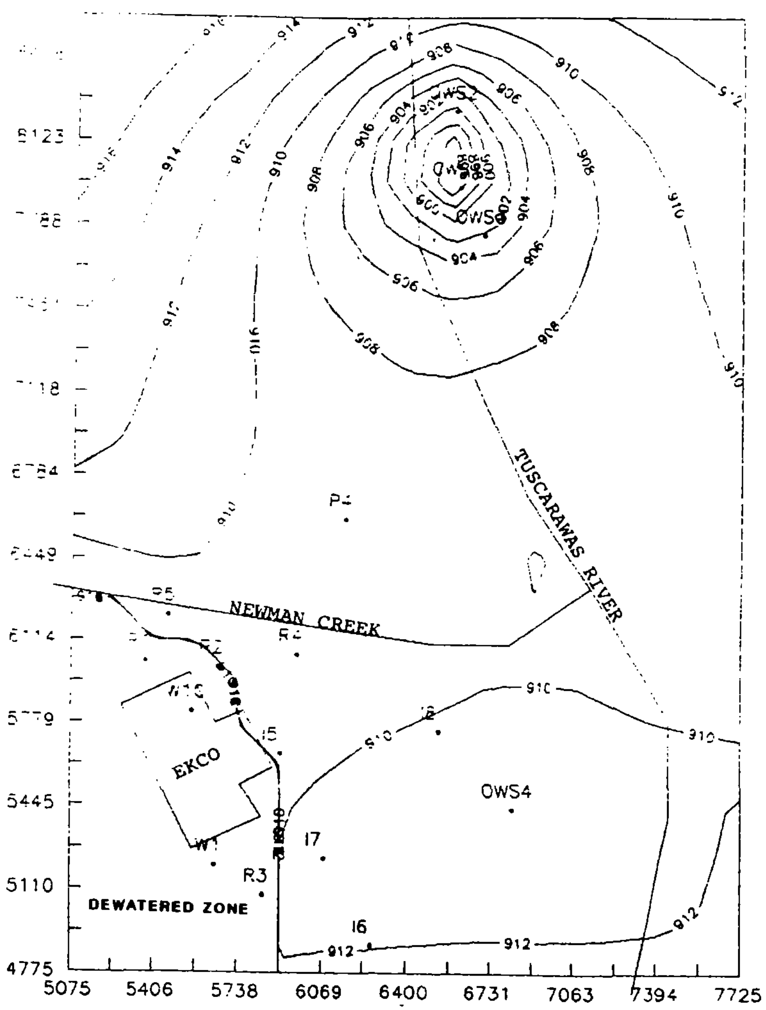
NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-4 EXCO MODEL
HYDRAULIC CONDUCTIVITY MA[P]
LAYER 1



NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-5 EKCO MODEL
BEDROCK TOP, LAYER 2



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	0
W-10	0

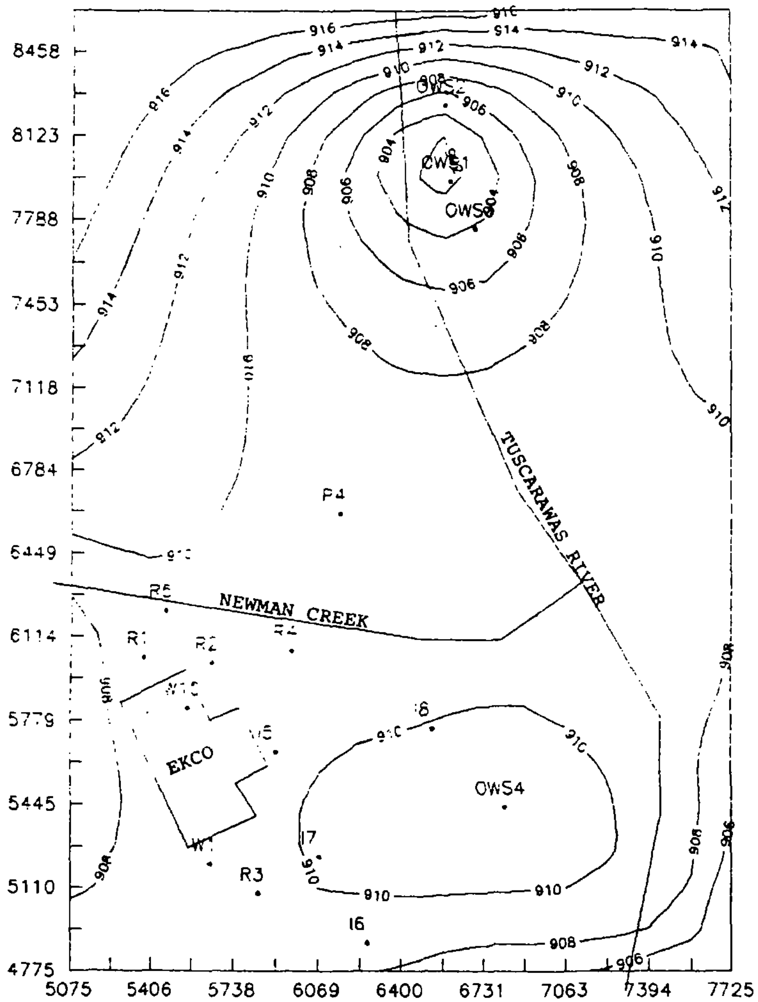
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Seal Level

FIGURE 4-6 EKCO MODEL
SIMULATION 1, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	0
W-10	0

SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Seal Level

FIGURE 4-7 EKCO MODEL
SIMULATION 1, LAYER 2

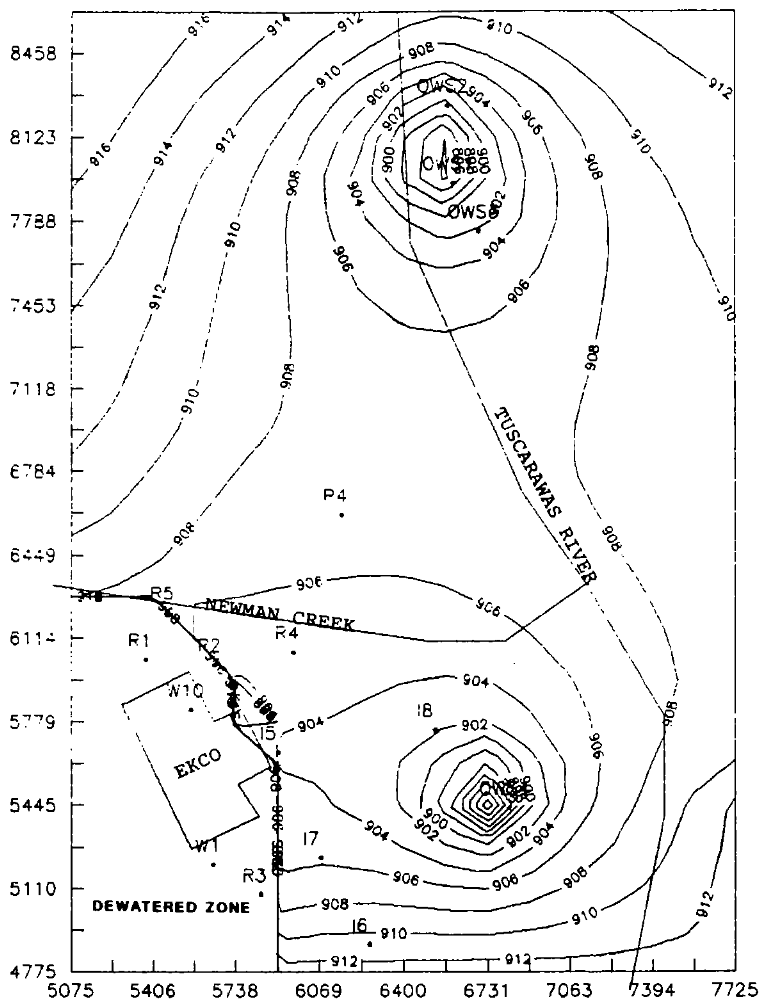
(one to three feet) and significantly in layer two (five to 15 feet). Actual water level rise may even be greater than that indicated above, because the model response is influenced by the constant head boundary nodes.

Simulation No. 2 was run to evaluate the effect on the groundwater system when OWS-4 was pumping at an estimated rate of 2,000 gpm, and the EKCO recovery wells were pumping at approximately one half their present rate (i.e., past conditions). Based on the simulation results, groundwater maps of layer 1 (Figure 4-8) and layer 2 (Figure 4-9) indicate that pumping OWS-4 would have had a significant effect on water levels in both layers; lowering water levels near OWS-4 in layer 1 as much as 24 feet, and layer 2 as much as 10 feet. The contour maps also indicate that the reduced pumping rates of W-1 and W-10 would have raised the water level somewhat in layer 2 (approximately 10 feet).

Three additional simulations were run to preliminarily evaluate potential remediation scenarios. In simulation No. 3, the observation well I-7 was simulated as a recovery well pumping at a rate of 250 gpm. I-7 is located southeast of the plant and is screened at the bottom of the unconsolidated deposits. The results of this simulation indicate a small drawdown in layer 1 around I-7 (of approximately four feet) (Figure 4-10), and a broadening of the cone of depression in layer 2 (Figure 4-11).

In simulation No. 4, I-7 was simulated as a recovery well pumping at a rate of 750 gpm. The results of this simulation indicate a much more significant drawdown in both layers. The groundwater contour map of layer one (Figure 4-12) indicates a local dewatered zone and a lower water level at the entire site, especially near I-7, where water levels are as much as 16 feet lower. The groundwater level in layer 2 (Figure 4-13) was also lowered at the site, and the cone of depression was extended around I-7.

Simulation five was run by doubling the pumping rates of W-1 and W-10 (W-1 set at 470 gpm; W-10 set at 670 gpm). This simulation indicates a significant effect on layer 2 (Figure 4-14), which exhibits as much as 10 feet of additional drawdown. Layer 1 (Figure 4-15) indicated a larger dewatered zone, with water levels approximately two feet lower on the site.



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	2000
W-1	117
W-10	167

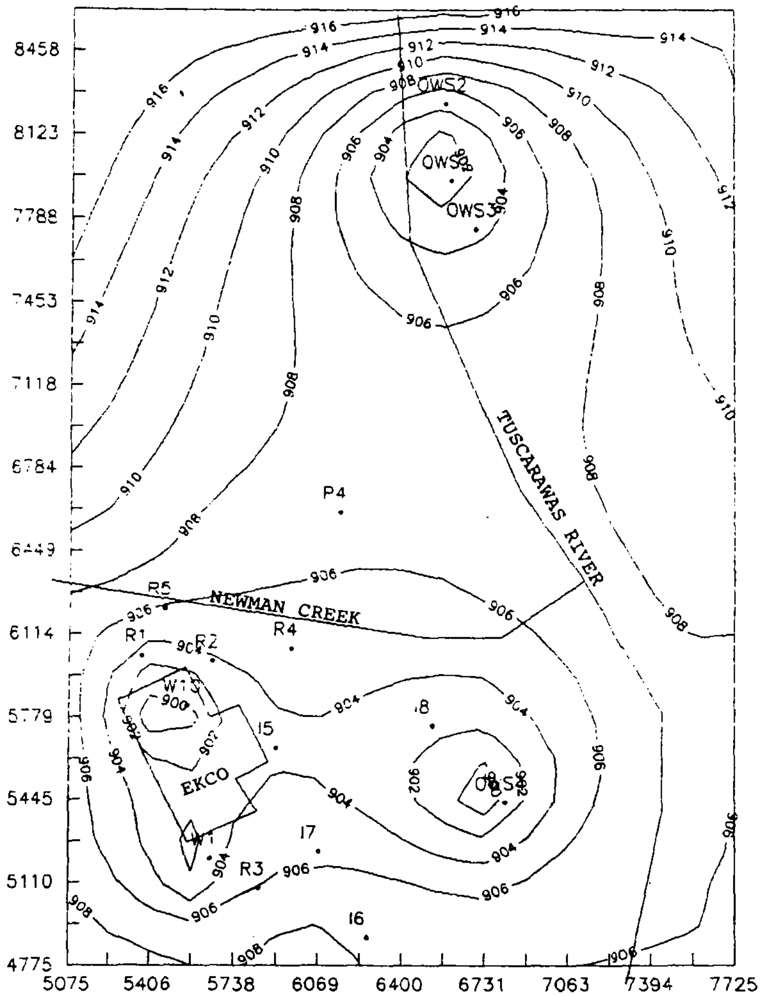
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Seal Level

FIGURE 4-8 EKCO MODEL
SIMULATION 2, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	2000
W-1	117
W-10	167

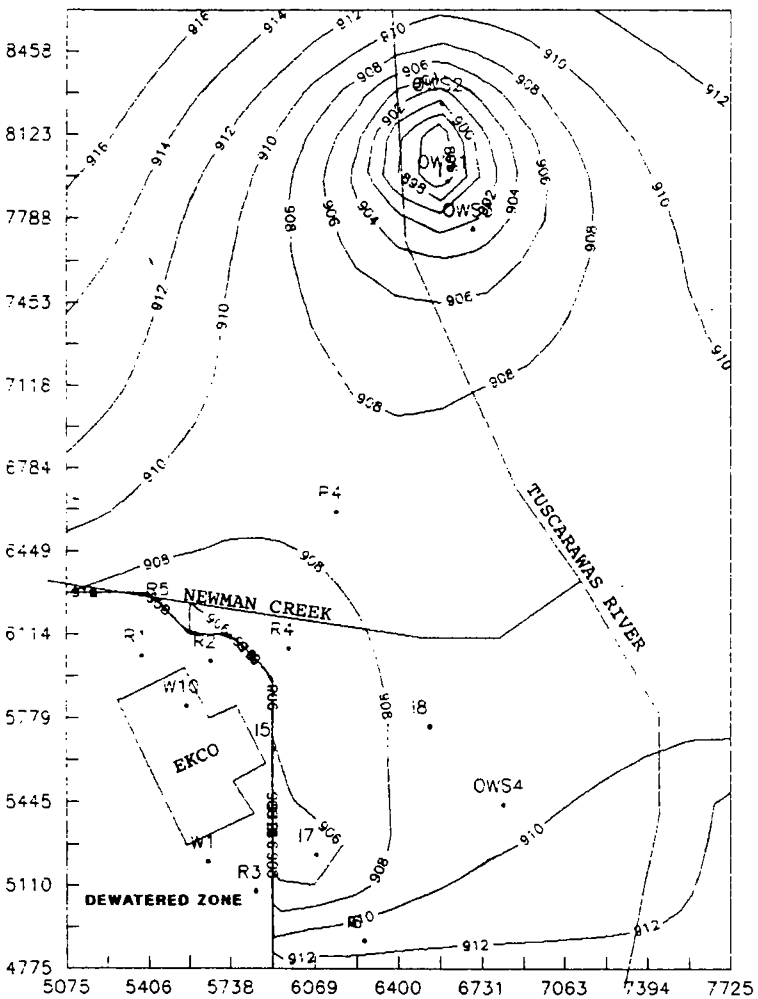
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Seal Level

FIGURE 4-9 EKCO MODEL SIMULATION 2, LAYER 2



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335
I-7	250

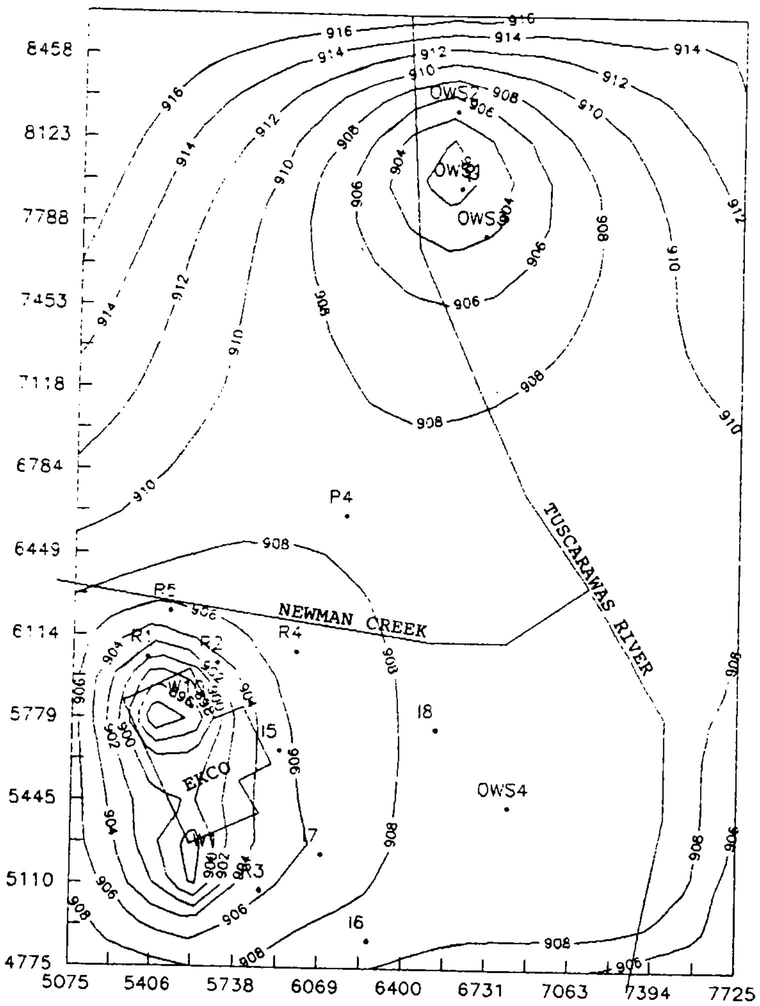
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-10 EKCO MODEL
SIMULATION 3, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335
I-7	250

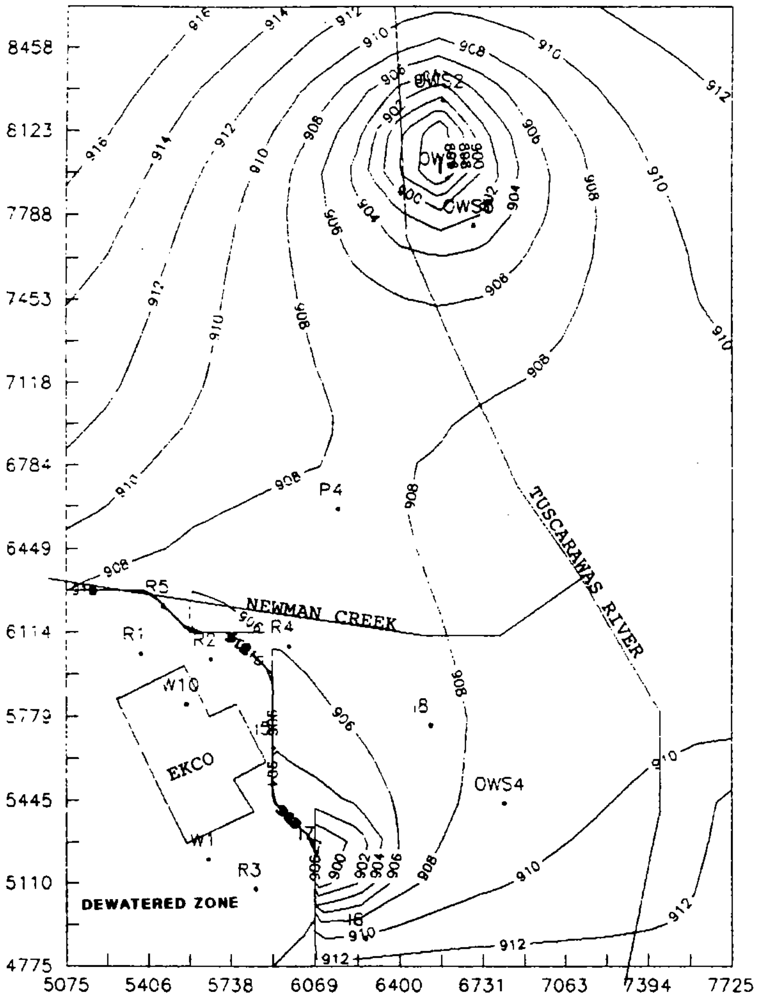
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-11 EKCO MODEL
SIMULATION 3, LAYER 2



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335
I-7	750

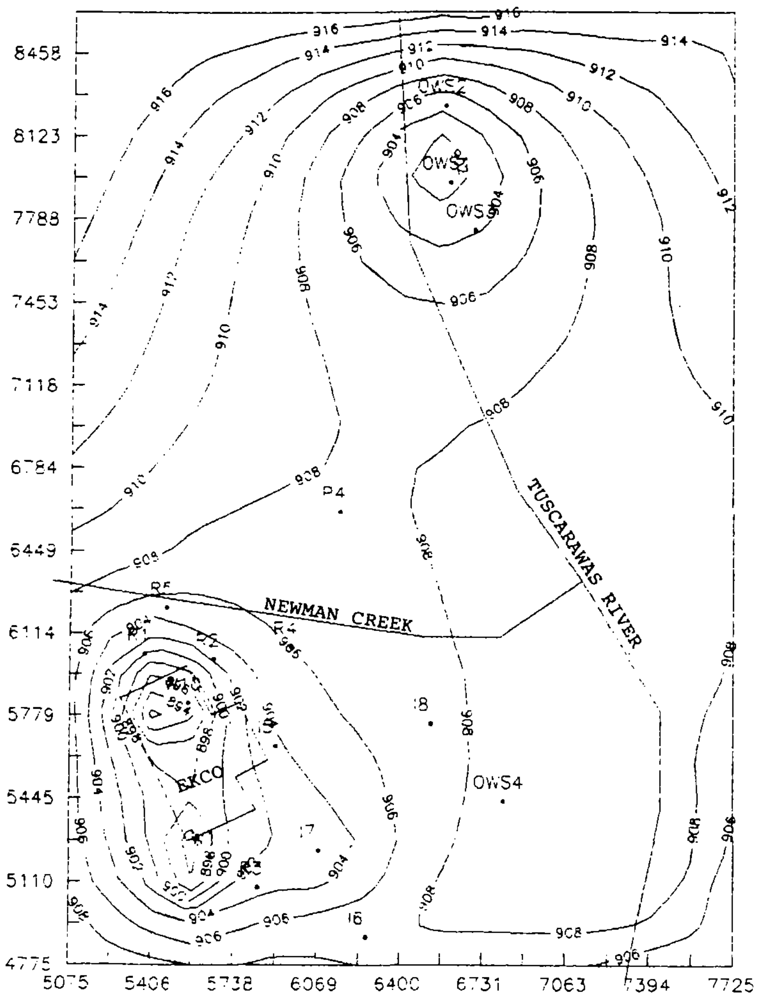
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-12 EKCO MODEL
SIMULATION 4, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	235
W-10	335
I-7	750

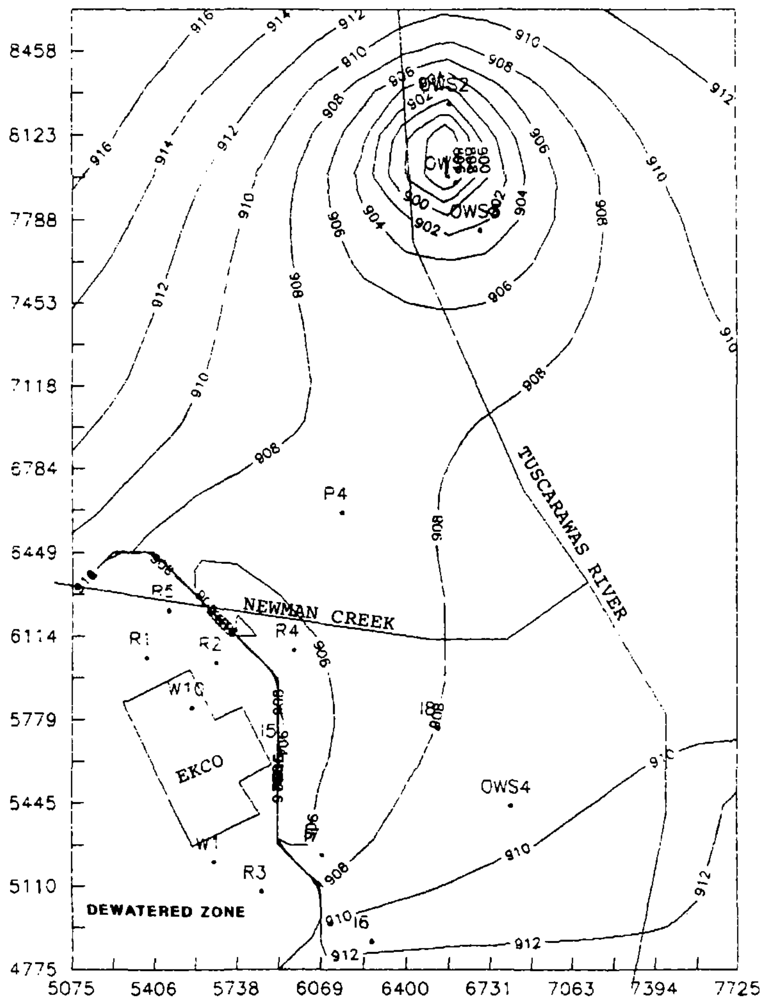
SCALE

0 500 1000 1500

feet

NOTE: Contours are in Feet Above Mean Sea Level

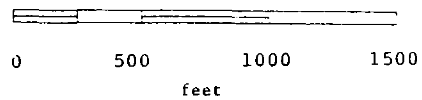
FIGURE 4-13 EKCO MODEL
SIMULATION 4, LAYER 2



SIMULATED PUMPING RATES

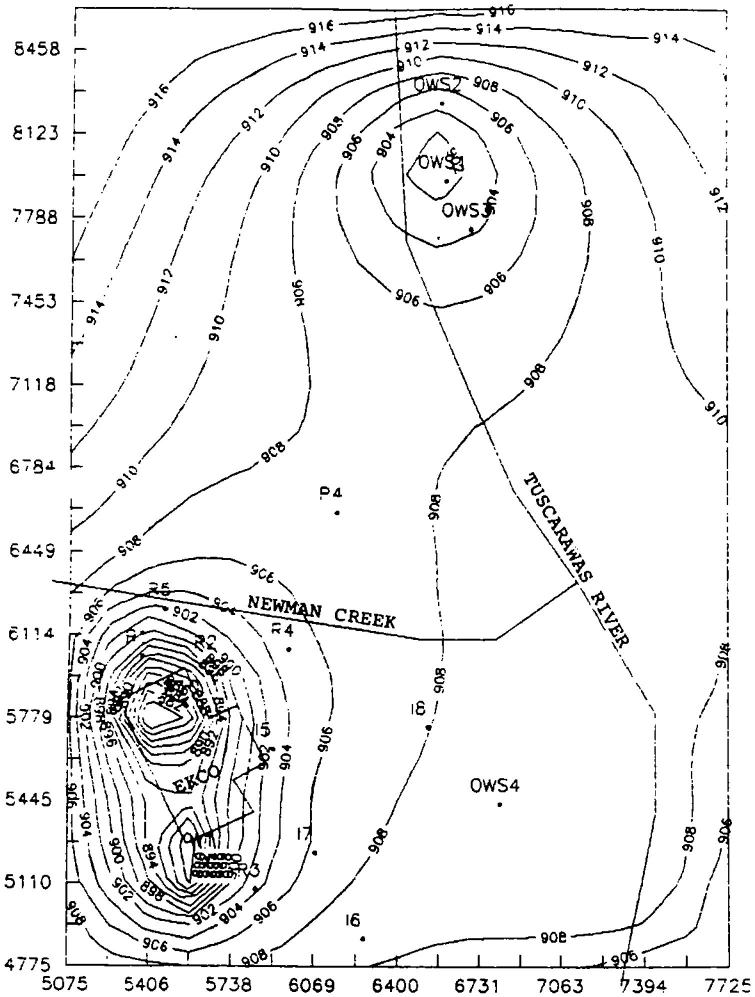
WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	470
W-10	670

SCALE



NOTE: Contours are in Feet Above Mean Sea Level

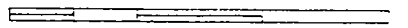
FIGURE 4-14 EKCO MODEL
SIMULATION 5, LAYER 1



SIMULATED PUMPING RATES

WELL	FLOW (gpm)
OWS-1	2800
OWS-2	1260
OWS-3	350
OWS-4	0
W-1	470
W-10	670

SCALE



NOTE: Contours are in Feet Above Mean Sea Level

FIGURE 4-15 EKCO MODEL
SIMULATION 5, LAYER 2

SECTION 5

CONCLUSIONS

The following conclusions are based on available data from the WESTON Phase I and Phase II field investigation efforts.

1. Bedrock groundwater flow at the site is toward the recovery wells, and contamination in this zone is being adequately recovered with present pumpage rates.

2. Shallow groundwater flow in the area of the lagoon is toward recovery well W-10.

3. There have probably been several episodes of contaminant release, some of which have occurred recently.

4. A portion of the groundwater in the unconsolidated deposits may be migrating offsite; further evaluation of this interval should be done.

5. Because the suite of VOCs detected in I-7 and I-8 is different from that detected in on-site wells, an off-site source may be responsible for contamination at I-7 and I-8.

6. Several probable on-site VOC source areas exist; the three most likely areas are: along the western side of the plant; the tank area near well D-4-30; and the sump at recovery well W-10.

7. Fill materials underlie much of the EKCO facility. Soil analyses performed on a number of samples from the fill indicate heavy metals concentrations well above the values presented in the Ohio Farm Soils guide. Groundwater analyses from on-site and nearby off-site wells have not shown the presence of detectable levels of heavy metals.

8. Utilizing a well screened in the unconsolidated deposits, such as I-7, for a recovery well, may be a viable step to assure complete containment of contaminants in the unconsolidated deposits.

9. Additional shallow and interface wells are needed to further evaluate groundwater quality.

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APPENDIX A

RESULTS OF INTERIM MEASURES GROUNDWATER SAMPLING

RESULTS OF 23 SEPTEMBER 1987 PRODUCTION AND MONITORING WELL
SAMPLES AT THE EKCO SITE
(ug/l)

	BEDROCK WELLS								SHALLOW WELLS			
	R-1	R-2	R-3	R-4	R-5	W-1	W-10	W-10D*	D-1-2	D-2-30	D-3-17	D-4-30
Acetone		12						110				26
2-Butanone												95
Carbon Disulfide												1J
Carbon Tetrachloride												220
Chloroform												13
Chloromethane												2J
1,1-Dichloroethane	15		4J			130	180	160	4J	97	160	8400
1,2-Dichloroethane		75						5				100
1,1-Dichloroethene	6	11				16	160	110		5	3J	20000
Methylene Chloride	3JB	3JB	4JB	4JB	3JB	3JB	4JB	5B	3JB	3JB	3JB	19B
Toluene							1J	2J				
Trans-1,2-Dichloroethene	65	200				17	110	84	4J	100	54	210
1,1,1-Trichloroethane	84	41	2J			100	3800	4500	18	9	10	180000
Trichloroethene	270	1100	2J			140	1700	2100	75B	36	16	57000
1,1,2 Trichloroethane												130
Vinyl Chloride	19	45					7J			86	110	10

Notes:
* = Duplicate Sample
J = Estimated Value
B = Analyte Found in Blank and Sample

RESULTS OF 3 SEPTEMBER 1987 OHIO WATER SERVICE COMPANY
WELL NO. 4 GROUND WATER SAMPLE
(ug/l)

	WELL #4	WELL #4 DUP	WELL #4 MATRIX SPIKE	WELL #4 MATRIX SPIKE DUP	FIELD BLANK	TRIP BLANK
Benzene	4.6	4.7	90%	97%	---	---
Chloroform	---	---	---	---	3.2	3.1
Tetrachloroethene	---	---	1.8	1.8	---	---
Trichlorofluoromethane	1.2	1.3	1.2	1.2	1.5	1.3
Vinyl Chloride	2.5	2.9	2.3	2.5	---	---

Notes:
--- = Analyzed, not detected

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APPENDIX B

PACKER TESTING METHODOLOGY

PACKER TESTING METHODOLOGY

The specific protocol for the straddle packer tests is as follows:

1. Decontaminate the packers and all downhole equipment.

2. Prior to testing each zone, obtain static water levels and calibrate the pressure transducers to these static levels (T.O.C.).

3. Inflate the packer(s) and allow each isolated portion of the borehole to stabilize. Double-check each pressure transducer and record the head values above, between, and below the packers.

4. Begin pumping of the test zone. Maintain a constant pump rate that will adequately stress the test zone (without dewatering the zone), and record changes in head in the test zone and in the isolated borehole above and below the packers. The objective is to obtain a stable drawdown (±0.5 ft) that can be maintained over a 30-minute period with constant rate pumping. Specific capacity values will be estimated by dividing pumping rates by the indicated drawdowns (gpm/ft).

5. Obtain analytical samples once a stable drawdown has been obtained and general water quality parameters have stabilized, and again just prior to termination of pumping. At least five test interval volumes should be pumped between each sample collection.

6. Stop the pumping phase of the test and close the flow control valve to prevent water in the purge line from reversing back down the hole. Monitor the recovery of head values until at least 90% recovery is obtained.

7. End the test and deflate the packers. The holes will be tested from bottom to top.

APPENDIX C

MONITOR WELL INSTALLATION METHODOLOGY

MONITOR WELL INSTALLATION METHODOLOGY

All newly constructed monitor wells will be constructed of 4-inch diameter wound-wire type 304 stainless steel screens, stainless steel risers, and a protective black iron surface casing with lockable cap. The shallow monitor wells will have 10-ft screens installed into the first encountered waterbearing zone (in the unconsolidated sediments). Similar construction of the bedrock interface wells will be used, except that the 10-ft screens will be installed to the bedrock/unconsolidated sediment interface. Wells near the OWS wellfield will be constructed with screens at depths within the reported screen intervals of the OWS wells.

At the determined depth in the shallow wells, the well screen and riser will be installed and the drive casing withdrawn to the top of the screen. Silica sand will be used to backfill the annular space after the casing is withdrawn. When plumbing the hole indicates that the sand pack is at the desired height, a 2-ft bentonite pellet seal will be placed on the top of the sand pack as the casing is gradually withdrawn. The shallow well will be completed by gravity-feeding a neat cement mixture into the remaining annual space. After completion, the grout will be checked for settlement and more neat cement added, if needed. The upper 2.5 ft of annular space will be filled with a cement/sand mixture and a protective casing will be installed.

Similar well installation techniques will be used for all other monitor interface wells. A natural sand pack will extend approximately 2 to 4 ft above the screen, and a bentonite slurry will be tremied from the top of the sand pack as the drive casing is gradually withdrawn so that no collapse of the borehole occurs. These wells will be completed by treming a neat cement mixture to the bottom of the hole to displace the water in the annular space. As the drive casing is slowly withdrawn, the level of the grout will be maintained inside the drive casing by pumping additional grout to the bottom of the hole. A protective black iron casing will then be installed. All data will be recorded on the well construction summary form.

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APPENDIX D

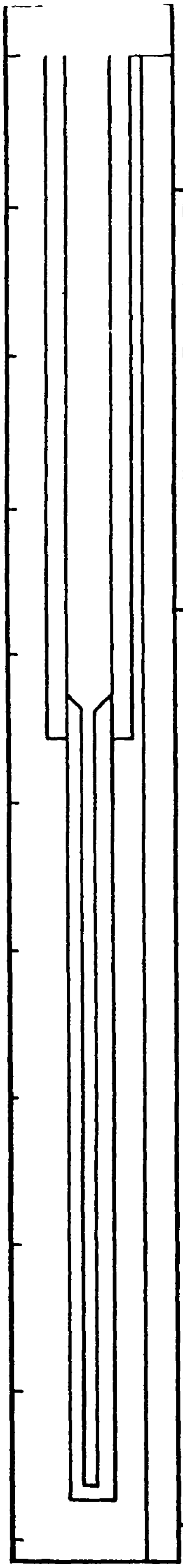
GEOLOGIC WELL LOGS AND CONSTRUCTION SUMMARIES

Well I-8D

Well Construction Summary

Location or Coords: 5740.959
6495.957

Elevation: Ground Level 931.1
Top of Casing 933.90



Location Massilon, Ohio
Personnel Thomas S. Cornuet
Project EKCO Housewares, Inc.

Drilling Summary:

Total Depth 250 feet
Borehole Diameter 8-inch, 6-inch

Driller Bowser-Morner, Inc.

Rig Cable tool rig
Bit(s) 8-inch, 6-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	String
0	143	C1
-2.5	167	C2
167	177	S1

Casing: C1 8-inch steel

C2 4-inch type 304 stainless steel

Screen: S1 4-inch type 304 .010 slot stainless steel

S2

Centralizers None

Filter Material #1 Sand

Cement Type II Portland Cement

Other

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	7/26/91	07:00	8/8/91	14:00
Geophys. Logging:	--	--	--	---
Casing:	7/26/91	07:00	8/8/91	14:00
Filter Placement:	8/8/91	12:18	8/8/91	12:18
Cementing:	8/9/91	14:15	8/9/91	1928
Development:				
Other:				

Well Development:

Grundfos Pump

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC.
WESTON
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DRILLING LOG

WELL NUMBER: I-8
OWNER:
LOCATION: 3rd Street NW
ADDRESS:
TOTAL DEPTH 250 feet
SURFACE ELEVATION: 931.1
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Lyndy Lawler

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-85					See Log for original I-8 Well.
85-87		SS			6" Recovery, silt (0-2" + (4'6") gray firm moist with 10% rock fragments (2-4") coarse, uniform wet light brown.
87-94		b			SILT, with sand and gravel lenses, wet, dark gray.
95-97		SS			NO RECOVERY
97-105		b			SAME AS ABOVE
105-107		SS			SILT with gravel, dark gray firm silt with gray shale up to 3/4" diameter subrounded, moist.
106-115		b			SAME AS ABOVE.
115-117		SS			NO RECOVERY.
117-120		b			SAND AND GRAVEL, gravel is up to 4 inches in diameter, subrounded sandstone.
120-130		b			SAME AS ABOVE.
130-132		SS			NO RECOVERY, gravel is probably too large to fit into split spoon.
130-140		b			SAND AND GRAVEL, with some silt, gravel is up to 4 inches in diameter.
140-142		SS			SAND, fine to medium with some gravel (30%) subrounded, up to 1 inch in diameter, a little silt (10%), firm dark gray. (3 in recovery) wet.
142-150		b			SAME AS ABOVE
150-152		SS			SAND AND GRAVEL dark gray, wet, subrounded 60% coarse sand, 30% gravel up to 1 inch diameter, 10% silt. (1 ft recovery).

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: I-8
OWNER:
LOCATION: 3rd Street NW
ADDRESS:
TOTAL DEPTH: 250 feet
SURFACE ELEVATION: 931.1
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Lyndy Lawler

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
151-160					SAME AS ABOVE
160-162		SS			SAND AND GRAVEL poorly sorted, saturated 60% sand, 30% gravel up to 1-1/2" 10% silt.
161-170		b			SAME AS ABOVE
170-172		SS			SAND AND GRAVEL, dark gray with some silt, saturated, gravel is up to 1" diameter, subrounded, sand is medium to coarse, 10% silt (1 ft recovery)
172-177		b			SAME AS ABOVE
177-180		b			fine SAND.
180-182		SS			Very fine SILT with some clay, very firm, gray slightly moist, very little water.
182-190		b			SAME AS ABOVE
190-192		SS			SAME AS ABOVE but slightly wetter
192-197		b			SAME AS ABOVE
197-199		SS			Dark gray SILT firm, dense, slightly moist. NOTE: 177 to 199 ft BGS interval produced very little water while drilling.
199-203		b			SAME AS ABOVE
203-210		b			SAME AS ABOVE
210-212		SS			Dark gray SILT very firm and stiff, slightly moist, some gravel (5%) up to 1-inch diameter, subrounded, 1 foot recovery.

* A.S.T.M. D1586

SHEET 2 OF 3

ROY F. WESTON INC.
WESTON
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DRILLING LOG

WELL NUMBER: I-8D
OWNER:
LOCATION: 3rd Street NW
ADDRESS:
TOTAL DEPTH: 250 feet
SURFACE ELEVATION: 931.1
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Lyndy Lawler

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
211-220			b		Gray well sorted SILT with some clay, OVA = background, no odor or discoloration.
220-222			SS		SAME AS ABOVE, slightly moist, zone would not yield much water, OVA = background.
230-232			b		Gray CLAY, very hard packed, dry with some fine sand and trace fine gravel, very difficult to break apart.
232-240			b		Gray CLAY with a little fine to medium sand and a trace clay and coal. Stiff formation, the borehole stayed open from 232 to 240 ft BGS.
240-242			SS		Medium SAND with a trace silt and fine gravel, bottom two inches is coarse sand, wet and friable.
242-245			b		SAND AND CLAY with a trace silt.
245-247			SS		SAME AS ABOVE, bottom 2 inches very hard stiff and dry clay with a trace
247-250			b		Gray CLAY with a little fine sand.
250-252			SS		Gray CLAY with a little medium sand and fine gravel, very hard and stiff, dry.
					E.O.B. = 250 feet

* A.S.T.M. D1586

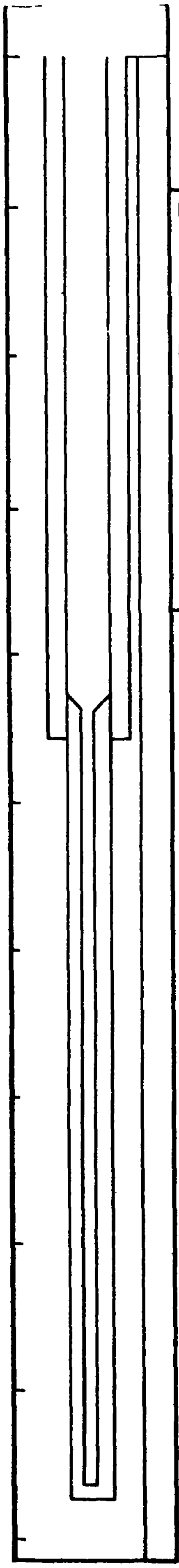
Well I-9

Well Construction Summary

Location Massillon, Ohio

Personnel

Project EKCO Housewares, Inc.



Location or Coords: 5903.980 N
6196.025

Elevation: Ground Level 929.8
Top of Casing 932.47

Drilling Summary:

Total Depth 173
Borehole Diameter 8-inch, 6-inch

Driller Bowser-Morner, Inc.
Dave Shrechengohst

Rig Cable Tool
Bit(s) 8-1/8, 6-1/8

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	6/4/91	13:00	6/8/91	19:00
Geophys. Logging:	--	--	--	--
Casing:				
Filter Placement:				
Cementing:				
Development:				
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

From	To	String
		C_1
	163	C_2
163	173	S_1

Casing: C1 8-inch steel

C2 4-inch Type 304 stainless steel

Screen: S1 4-inch Type 304 .010 slot stainless steel

S2

Centralizers None

Filter Material #2 sand and natural

Cement Type I Portland (27 bags)

Other

Well Development:

Removed 5 + well volumes with a grundfos pump at gpm while monitoring pH, conductivity and temperature

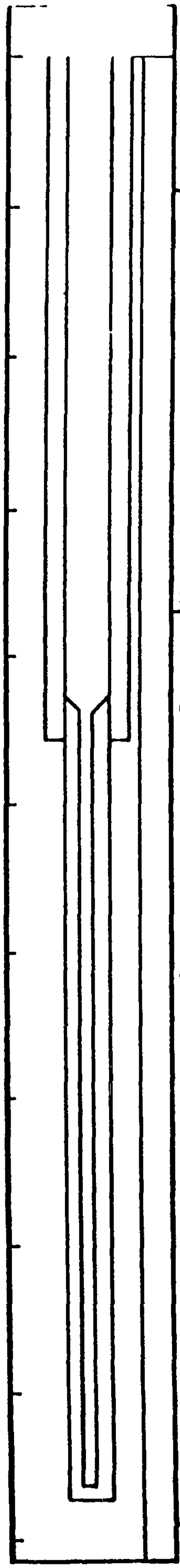
Comments:

WESTON DESIGNERS CONSULTANTS

Project EKCO Housewares, Inc.

Location Massillon, Ohio

Personnel



Well I-9

Well Construction Summary

Location or Coords: 5903.980 N
6196.025

Elevation: Ground Level 929.8

Top of Casing 932.47

Drilling Summary:

Total Depth 173

Borehole Diameter 8-inch, 6-inch

Driller Bowser-Morner, Inc.
Dave Shrechengohst

Rig Cable Tool

Bit(s) 8-1/8, 6-1/8

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C = Casing S = Screen

-		C_1
-	163	C_2
163 -	173	S_1

Casing: C1 8-inch steel

C2 4-inch Type 304 stainless steel

Screen: S1 4-inch Type 304 .010 slot stainless steel

S2

Centralizers None

Filter Material #2 sand and natural

Cement Type I Portland (27 bags)

Other

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	6/4/91	13:00	6/8/91	19:00
Geophys. Logging:	--	--	--	--
Casing:				
Filter Placement:				
Cementing:				
Development:				
Other:				

Well Development:

Removed 5 + well volumes with a grundfos pump at gpm while monitoring pH, conductivity and temperature

Comments:

WESTON
DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: I-9

OWNER: Ohio Water Service

LOCATION: Massillon, Ohio

ADDRESS:

TOTAL DEPTH: 173

SURFACE ELEVATION:

WATER LEVEL: 13.6

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: Cable Tool

DATE DRILLED: 6/4/91

DRILLER: Dave Schrencengost

HELPER: Bill Kessler

LOG BY:

SKETCH MAP

N

Newman Creek

I-9

NOTES:

DEPTH (FEET)	OVA	% Recovery	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
5-7			SS		Clay, sand and gravel.
10-12			SS		Same as above
15-17			SS		Brown sand and grave, wet.
20-22			SS		Same as above.
[illegible]			SS		Same as above.
30-32			SS		Same as above.
36-38			SS		Gray clay with some sand and gravel.
40-42			SS		Fine sand, gray gravel.
60-62			SS		Fine sand, trace clay.
65-67			SS		Sand, gravel, trace clay.
70-72			SS		Fine sand.
75-77			SS		Fine sand.
80-82			SS		Gray clay and gravel.
85-87			SS		Gray clay and gravel.
90-92			SS		Sand and gravel.
100-102			SS		Sand and gravel.
125-127			SS		Same as above.
146-148			SS		Same as above.
150-152			SS		Same as above.
152-154			SS		Same as above.

* A.S.T.M. D1586

SHEET ___ OF ___

WESTON

DRILLING LOG

WELL NUMBER: I-9
OWNER: Ohio Water Service
LOCATION: Massillon, Ohio
ADDRESS:
TOTAL DEPTH: 173
SURFACE ELEVATION:
WATER LEVEL: 13.6
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED: 6-4-91
DRILLER: Dave Schrencengost
HELPER: Bill Kessler
LOG BY:

SKETCH MAP

NOTES:

DEPTH (FEET)	OVA	% Recovery	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
163-165			SS		Brown sand and gravel.
170-172			SS		Same as above.
172-173			SS		Weathered shale.

* A.S.T.M. D1586

SHEET ___ OF ___

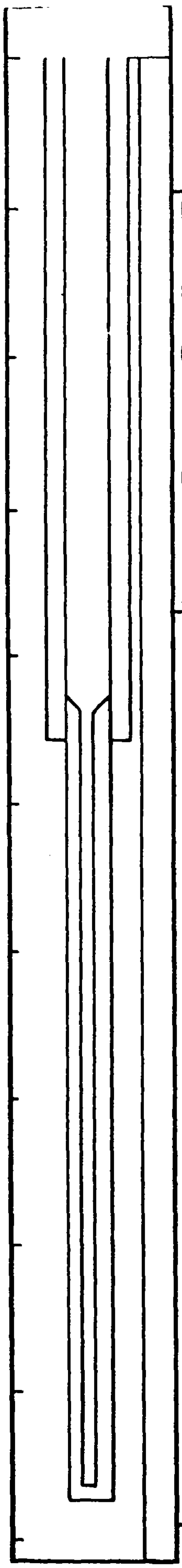
Well I-10

Well Construction Summary

Location or Coords: 6258.461 N
5673.493 E

Elevation: Ground Level 932.9
Top of Casing 936.10

Location Massillon, Ohio
Personnel
Project EKCO Housewares, Inc.



Drilling Summary:

Total Depth 35 feet
Borehole Diameter 8 inches

Driller Bowser-Morner, Inc.

Rig Cable Tool Rig
Bit(s) 8-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	7/24	10:50	7/24	16:00
Geophys. Logging:	-	-	-	-
Casing:	7/24	15:05	7/24	16:00
Filter Placement:	7/24	16:00	7/24	16:25
Cementing:	7/25	8:05	7/25	9:45
Development:				
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	String
-2.5	24	C1
24	34	S1

Casing: C1 Type 304 Stainless Steel

C2

Screen: S1 Type 304 .010 slot Stainless Steel

S2

Centralizers None

Filter Material 5 bags No. 2 Sand

Cement (1½) batches (68 gals.) Portland Type II Cement

Other (1) 5-gallon bucket Bentonite Pellets

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-10 OWNER:
LOCATION: Price Bros. ADDRESS:

TOTAL DEPTH 35 feet
SURFACE ELEVATION: 932.9 WATER LEVEL:
DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:
DRILLER: HELPER:
LOG BY:

SKETCH MAP

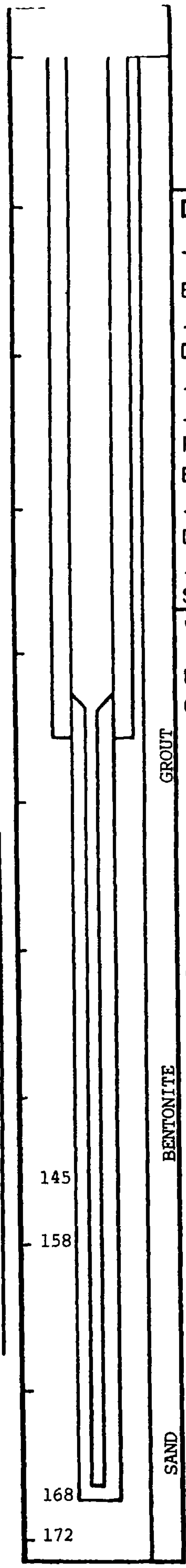
NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
					See Geology Log forl Well R-10 for interval 0 to 35 feet below ground surface.

* A.S.T.M. D1586

SHEET ___ OF ___

Location Massillon, Ohio
Personnel Pat Doran
Project EKCO Housewares, Inc.



Well I-11

Well Construction Summary

Location or Coords: 6451.415 N.
6288.993 E.

Elevation: Ground Level 931.4
Top of Casing 933.42

Drilling Summary:

Total Depth 172
Borehole Diameter 8-inch, 6-inch

Driller Bowser, Morner, Inc.

Rig Cable Tool
Bit(s) 8-inch, 6-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	6/24	16:45	6/29	16:00
Geophys. Logging:	--	--	--	--
Casing:	6/30	11:15	6/30	13:45
Filter Placement:	6/30	13:45	6/30	15:00
Cementing:	7/1	10:00	7/1	16:00
Development:				
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	String
-2.5	158	C1
0	100	C2
158	168	S1

Casing: C1 4-inch Stainless Steel type 304
C2 8-inch Steel Casing

Screen: S1 4-inch Stainless Steel .010 Slot type 304
S2

Centralizers None

Filter Material (5.5) 50-pound bags of No. Sand and natural sand pack.

Cement Portland Type II Cement

Other Bentonite Slurry

Well Development:

Grundfos Pump

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC.

WESTON

DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-11 OWNER:

LOCATION: Carter Lumber ADDRESS:

TOTAL DEPTH 172 feet

SURFACE ELEVATION: 931.4 WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: Cable Tool DATE DRILLED:

DRILLER: Dave Shrecongost HELPER: Bill Kessler

LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-18			--		See S-11 Drilling Log.
18-25			b		Gray well sorted GRAVEL AND SAND, trace silt.
25-27			SS		SAME AS ABOVE
27-30			b		SAME AS ABOVE
30-32			SS		SAME AS ABOVE
32-35					~~SAME AS ABOVE~~
35-37			SS		Brown and gray SAND AND GRAVEL with a little silt
37-40			b		SAME AS ABOVE
40-49.5			b		Yellow brown well sorted SAND AND GRAVEL, no silt or clay, material is heaving into the borehole.
49.5-50.5			b		SAME AS ABOVE with coarser gravel
50.5-55			b		SAME AS ABOVE
55-57			SS		Dark gray well sorted SAND AND GRAVEL with a 2-inch coarse silt layer at bottom of spoon.
57-60			b		SAME AS ABOVE
60-62			SS		Dark gray well sorted SAND AND GRAVEL
62-65			b		SAME AS ABOVE
65-67			SS		Dark gray SILT with some clay, trace coarser sand and gravel, still, moist.
67-70			b		SAME AS ABOVE
70-72			SS		SAME AS ABOVE with slightly more gravel

* A.S.T.M. D1586

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-11
OWNER:
LOCATION: Carter Lumber
ADDRESS:

TOTAL DEPTH 172 feet
SURFACE ELEVATION: 931.4
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
72-75			b		SAME AS ABOVE
75-77					SAME AS ABOVE, with slightly more gravel, very stiff.
77-80			b		SAME AS ABOVE
80-82			SS		SAME AS ABOVE with limited recovery.
82-85			b		SAME AS ABOVE
85-87			SS		Dark gray SILT with some clay, with a trace sand and gravel, very stiff, moist.
88-90			b		SAME AS ABOVE
90-92			SS		SAME AS ABOVE
92-95			b		SAME AS ABOVE
95-97			SS		SAME AS ABOVE
97-100			b		SAME AS ABOVE
100-102			SS		Dark gray CLAY with some silt and a trace of fine to coarse sand and gravel, stiff.
102-110			b		SAME AS ABOVE
110-120			b		SAME AS ABOVE
120-130			b		SAME AS ABOVE
130-132			SS		SAME AS ABOVE
132-145			b		SAME AS ABOVE
145-147			SS		Gray well sorted fine to coarse SAND AND GRAVEL.

* A.S.T.M. D1586

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-11
OWNER:
LOCATION: Carter Lumber
ADDRESS:
TOTAL DEPTH 172 feet
SURFACE ELEVATION: 931.4
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Pat Doran

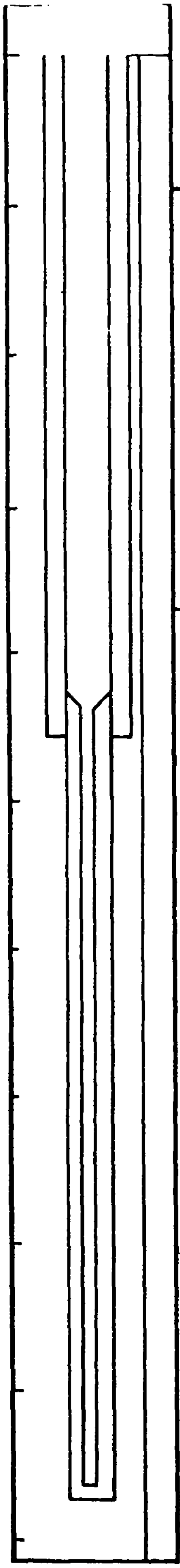
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
147-151			b		SAME AS ABOVE
151-155			b		SAME AS ABOVE with less gravel
155-157			SS		Gray fine to medium SAND with a little gravel and a little silt.
157-165			b		SAME AS ABOVE
165-167			SS		SAME AS ABOVE
167-172			b		SAME AS ABOVE
172-			SS		Slightly weathered light gray SANDSTONE fragments, drive casing not advancing at all, split spoon only advanced 2 inches with 100 blows.
					E.O. B = 172 feet

* A.S.T.M. D1586

Project EKCO Housewares, Inc.
Location Massillon, Ohio
Personnel Dave Cairns



Well I-12

Well Construction Summary

Location or Coords: 6694.869 N
5868.330 E

Elevation: Ground Level 942.2
Top of Casing 944.96

Drilling Summary:

Total Depth 62 feet
Borehole Diameter 8 inches

Driller Bowser-Morner, Inc.

Rig Cable Tool
Bit(s) 8-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log X Geophysical Log --
Casing String(s): C=Casing S=Screen

0 - 47	C1	
-2.5 - 52	C2	
52' - 62'	S1	

Casing: C1 8-inch steel

C2 4-inch Stainless Steel
Type 304

Screen: S1 4-inch Stainless Steel
.010 slot Type 304

S2

Centralizers None

Filter Material (8) 50-pound bags No. 1 Sand

Cement Portland Type II Cement

Other 1 (5) gallon bucket of
Bentonite Pellets

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	7/10	15:20	7/12	10:35
Geophys. Logging:	--	--	--	--
Casing:	7/12	10:35	7/12	11:00
Filter Placement:	7/12	11:00	7/12	11:00
Cementing:				
Development:	7/16	7:20	7/16	9:30
Other:				

Well Development:

Grundfos Pump

Comments:

WESTON
DESIGNERS CONSULTANTS

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-12
OWNER:
LOCATION: Price Bros.
ADDRESS:
TOTAL DEPTH: 62
SURFACE ELEVATION: 942.2
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED: 7/11/91
DRILLER: Dave Shrecongost
HELPER: Bill Kessler
LOG BY: Dave Cairns

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
					See S-12 and R-12 Drilling Log for Lithologic Description

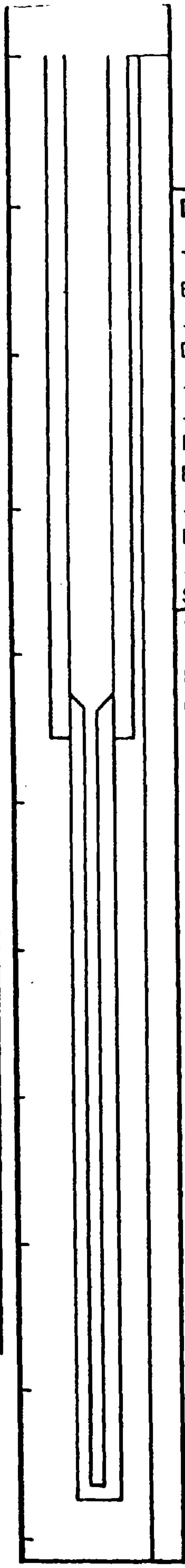
* A.S.T.M. D1586

SHEET ___ OF ___

Project EKCO Housewares, Inc.

Location Massillon, Ohio

Personnel Pat Doran



Well I-13

Well Construction Summary

Location or Coords: 7627.180 N
6631.564 E

Elevation: Ground Level 931.0
Top of Casing 933.92

Drilling Summary:

Total Depth 150 feet

Borehole Diameter 8-inch, 6-inch

Driller Bowser-Morner

Rig Cable Tool

Bit(s) 8-inch, 6-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:			6/19	17:10
Geophys. Logging:	--	--	--	--
Casing:	6/19	17:10	6/20	9:00
Filter Placement:	6/20	9:00	6/20	11:00
Cementing:	6/20	11:00	6/20	18:45
Development:				
Other:				

Well Design:

Basis: Geologic Log ____ Geophysical Log ____

Casing String(s): C = Casing S = Screen

From	To	String
-2.5'	150'	C1
140'	150'	S1

Casing: C1 4-inch Stainless Steel
Type 304

C2

Screen: S1 4-inch Stainless Steel
.010 slot, Type 304

S2

Centralizers None

Filter Material (4) 50-pound bags No. 1
Sand, and natural sand pack

Cement Portland Type II Cement

Other (1) bucket Bentonite Pellets

Well Development:

Grundfos Pump

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: I-13
LOCATION: Ohio Water Service
Lake Avenue

OWNER:
ADDRESS:

TOTAL DEPTH: 150 feet
SURFACE ELEVATION:
WATER LEVEL:

DRILLING COMPANY: Bowser-Morner
DRILLING METHOD:
DATE DRILLED:
DRILLER: Dave Shrencongost
HELPER: Bill Kessler

LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	OVA	% Recovery	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
5-7			SS		Brown clay, some gravel.
10-12			SS		Gray sand.
15-17			SS		Black sand, red clay, gravel.
20-22			SS		Clay gravel and sand.
25-26			SS		Sand clay and gravel.
30-32			SS		Sand and gravel clay.
35-37			SS		Gray clay and sand, gravel.
40-42			SS		Gray silt and clay, some sand.
45-47			SS		Same as above.
49-51			SS		Gray clay, sand and gravel.
55-57			SS		Same as above.
60-62			SS		Gray clay, little gravel.
65-67			SS		Same as above.
70-72			SS		Same as above.
75-77			SS		Same as above.
80-82			SS		Same as above.
85-87			SS		Same as above.
90-92			SS		Same as above.
95-97			SS		Gray silt clay and sand.
100-102			SS		Same as above.
105-107			SS		Same as above.

* A.S.T.M. D1586

SHEET ____ OF ____

WESTON

DRILLING LOG

WELL NUMBER: I-13 OWNER:

LOCATION: Ohio Water Service Lake Avenue ADDRESS:

TOTAL DEPTH 150 feet

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: DATE DRILLED:

DRILLER: Dave Shrecongost HELPER: Bill Kessler

LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
110-112			SS		Dark gray well sorted medium SAND AND GRAVEL with a little clay and silt, wet.
112-115			b		SAME AS ABOVE
115-117			SS		Gray well sorted medium SAND AND GRAVEL with a trace silt and clay, wet.
117-126			b		SAME AS ABOVE
126-128			SS		SAME AS ABOVE with slightly more silt and clay trace coal fragments
128-131			b		SAME AS ABOVE
131-133			SS		SAME AS ABOVE with less silt and clay, well sorted.
133-135			b		SAME AS ABOVE
135-137			SS		SAME AS ABOVE with less coarse gravel.
137-140			b		SAME AS ABOVE
140-142			SS		SAME AS ABOVE, with a trace silt and clay.
142-145			b		SAME AS ABOVE
145-147			SS		Medium SAND AND GRAVEL, well sorted, no clay or silt.
147-150					SAME AS ABOVE
150-152			SS		SAME AS ABOVE
					E.O.B = 150 feet

* A.S.T.M. D1586

SHEET ____ OF ____

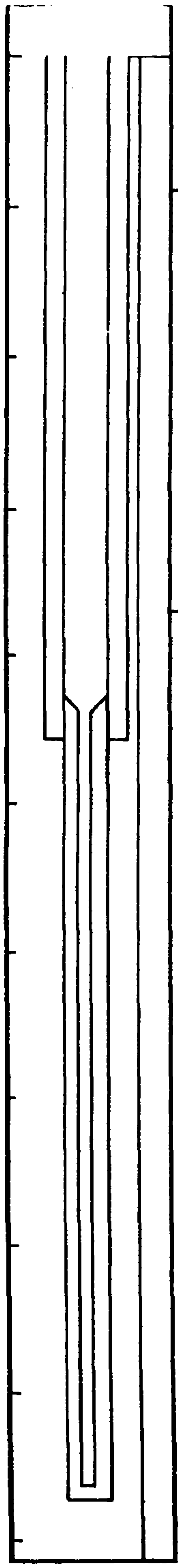
Well I-14

Well Construction Summary

Location or Coords: 8330.522 N
6595.422 E

Elevation: Ground Level 929.8
Top of Casing 932.55

Project EKCO Housewares, Inc.
Location Massillon, Ohio
Personnel



Drilling Summary:

Total Depth 150 feet
Borehole Diameter 8-inch

Driller Bowser-Morner, Inc.

Rig Cable Tool Rig
Bit(s) 8-inch Drive Shoe

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log Y Geophysical Log N
Casing String(s): C=Casing S=Screen

Casing: C1 8-inch steel

C2 4-inch Type 304 stainless steel

Screen: S1 4-inch Type 304 .010 slot stainless steel

S2

Centralizers

Filter Material (4) 50-pound bags of No. 1 Sand

Cement (3) batches (135 gals.) Portland Type II Cement

Other (1) 5-gallon bucket Bentonite Pellets

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	8/21	16:20	8/25	10:27
Geophys. Logging:	-	-	-	-
Casing:	8/26	12:05	8/26	18:04
Filter Placement:				
Cementing:				
Development:				
Other:				

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON, INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-14 OWNER:
LOCATION: ADDRESS:

TOTAL DEPTH 150 feet
SURFACE ELEVATION: WATER LEVEL:
DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:
DRILLER: HELPER:

LOG BY: T. Cornuet

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-3			b		Dark brown CLAY with a trace silt and poorly sorted fine to coarse sand, dry.
3-10			b		Brown to gray brown poorly sorted fine to coarse SAND with some poorly sorted fine to medium subangular gravel. Amount of gravel increases with depth, zone is producing water.
10-12			SS		Brown poorly sorted medium to coarse SAND with some poorly sorted fine to medium gravel and a little clay and silt, wet.
12-16			b		SAME AS ABOVE, encountered a stiff, firm clay layer at 15 to 16 feet.
16-17			--		Large boulder, very difficult to drill through.
17-20			b		Same as 12 to 16-foot interval with coarser sand.
20-22			SS		Moderately well sorted SAND, subangular with a trace medium gravel. Gravel is subrounded. Sample is friable and wet and water producing zone, highly permeable, has a trace of brown clay.
22-30			b		SAME AS ABOVE, amount of gravel decreases with depth.
30-32			SS		Top 12 inches: Moderately well sorted, medium to coarse subrounded SAND, with a trace silt and clay, friable and wet. Bottom 12 inches: fine well sorted gray sand, no gravel and almost no clay or silt, friable and wet.
32-40			b		Same as bottom 12 inches of previous sample.

* A.S.T.M. D1586

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-14 OWNER:
LOCATION: ADDRESS:

TOTAL DEPTH 150 feet
SURFACE ELEVATION: WATER LEVEL:
DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:
DRILLER: HELPER:

LOG BY: T. Cornuet

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40-42			SS		Top 18 inches: Well sorted fine gray sand, friable. Bottom 6 inches: Fine gray sand and clay with trace moderately angular gravel, soft and plastic.
42-50			b		SAME AS ABOVE with sand grain site increasing with depth.
50-52			SS		Poorly sorted angular coarse SAND with some gray clay and a trace poorly sorted subangular gravel, fairly soft and plastic, moist to dry. Low permeability. A few 1/4-inch layers of yellow brown clay.
52-60			b		SAME AS ABOVE with increasing clay with depth, zone is not producing water
60-62			SS		Gray soft clay with some coarse subangular poorly sorted SAND and fine to medium subangular gravel, moist to dry, soft and plastic, very low permeability.
62-70			b		SAME AS ABOVE, zone not producing water.
70-77					Gray soft clay with some fine moderately sorted and rounded gravel, and a little well-sorted fine sand, moderately plastic, slightly moist.
72-80			b		SAME AS ABOVE, amount of gravel increases with depth.
80-82			SS		Fine subrounded to subangular gravel with some gray clay and a trace light brown clay, a little poorly sorted medium to coarse subrounded sand. Partially friable and partially soft and plastic, moist
82-86			b		SAME AS ABOVE

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: I-14 OWNER:

LOCATION: ADDRESS:

TOTAL DEPTH: 150 feet

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:

DRILLER: HELPER:

LOG BY: T. Cornuet

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
86-90			b		Medium to coarse moderately sorted gravel with a little clay and silt produces a lot of water.
90-92			SS		Moderately well sorted medium brown SAND with a trace coarse gravel and clay, friable and wet.
92-103			b		SAME AS ABOVE, zone is producing water.
103-105			SS		Moderately sorted subangular coarse SAND with a medium to coarse gravel and a trace dry. Same 1/2 inch thick layers of gray clay. Sample is part friable and part soft and plastic.
105-110			b		SAME AS ABOVE
110-112			SS		SAME AS ABOVE
112-120					SAME AS ABOVE
120-122			SS		Top 12 inches: same as above. Middle 6 inches: light gray and yellow sandstone. Bottom 6 inches: gray well sorted sand with a trace clay, wet, zone is producing water.
122-125					Same as lower zone in previous sample.
125-127			SS		Coarse gravel and cobbles up to 4 inches in diameter, well rounded.
127-130			b		Poorly sorted clay sand and gravel.

* A.S.T.M. D1586

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-14 OWNER:
LOCATION: ADDRESS:

TOTAL DEPTH 150 feet
SURFACE ELEVATION: WATER LEVEL:
DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:
DRILLER: HELPER:

LOG BY: T. Cornuet

SKETCH MAP

NOTES:

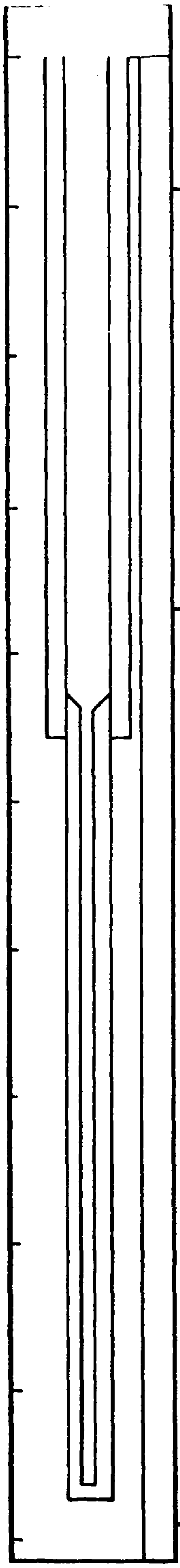
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
130-132		SS			Very poorly sorted medium to coarse SAND with some fine to medium gravel and some clay. Thin 2 to 3-inch layers which alternated high to low clay content. Some are soft and plastic and only moist. The rest is friable and wet. Moderate water producing zone.
132-136		b			SAME AS ABOVE
136-140		b			Moderately well sorted medium to coarse SAND with some fine gravel and a trace clay. Moderately rounded. Zone is producing a lot of water.
140-142		SS			Moderately well sorted medium SAND with some fine gravel and a trace coarse gravel and clay, wet.
142-150		b			SAME AS ABOVE
150-152		SS			SAME AS ABOVE

* A.S.T.M. D1586

Project EKCO housewares, Inc.

Location Massillon, Ohio

Personnel



Well R-7

Well Construction Summary

Location or Coords: 5217-323 N

6052.616

Elevation: Ground Level 939.5

Top of Casing 942.06

Drilling Summary:

Total Depth 99 feet

Borehole Diameter 8 inches

Driller Bowser-Morner, Inc.

Rig Cable Tool Rig

Bit(s)

Drilling Fluid Potable Water

Surface Casing

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	8/12	8:41	8/13	17:36
Geophys. Logging:	-	-	-	-
Casing:	8/14	8:58	8/14	10:43
Filter Placement:	8/14	10:43	8/14	11:15
Cementing:	8/20	8:05	8/20	17:45
Development:				
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

0 -	72.5	C1
-2.5 -	89	C2
89 -	99	S1

Casing: C1 8-inch steel

C2 4-inch Type 304 stainless steel

Screen: S1 4-inch Type 304 .010 slot stainless steel

S2

Centralizers None

Filter Material (4) 50-pound bag of No. 1 Sand

Cement (2) batches (90) gals. Portland Type II Cement

Other (1) 5-gallon bucket Bentonite Pellets

Well Development:

Bailed well with rig for 45 minutes.

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: R-7 OWNER:
LOCATION: ADDRESS:

TOTAL DEPTH: 99 feet
SURFACE ELEVATION: WATER LEVEL:
DRILLING COMPANY: DRILLING METHOD: DATE DRILLED:
DRILLER: HELPER:
LOG BY:

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-68					See Drilling Log for Well I-7.
68-70			SS		Brown to red-brown SANDSTONE, well sorted, moderately angular fine sand.
70-80			b		Brown to red-brown SANDSTONE, well sorted, moderately angular fine sand.
80-85			b		Brown to yellow-brown SANDSTONE, sand is medium with a little coarse, trace black sand, subrounded to subangular, well sorted, zone is producing water. The sandstone has been very competent with no cavein and no shale.
85-95					Light yellow-brown SANDSTONE with some coarse sand
95-99					SAME AS ABOVE, no problems with sandstone caving in, no shale.

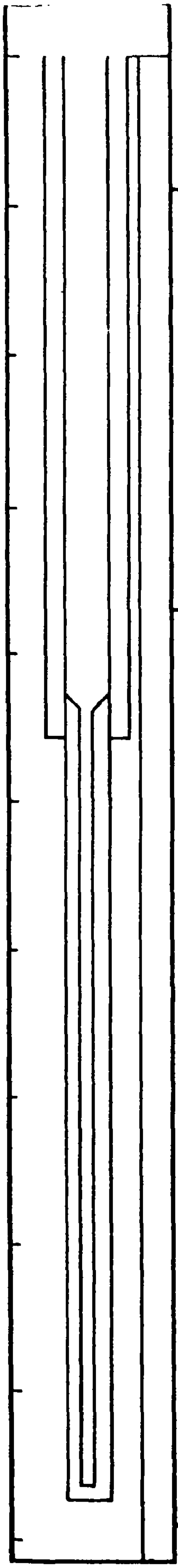
* A.S.T.M. D1586

SHEET ___ OF ___

Project EKCO Housewares, Inc.

Location Massillon, Ohio

Personnel



Well R-10

Well Construction Summary

Location or Coords: 6262.057 N
5669.018 E

Elevation: Ground Level 932.9

Top of Casing 936.21

Drilling Summary:

Total Depth 106.3 feet

Borehole Diameter 8-inch

Driller Bowser-Morner, Inc.

Rig Cable Tool Rig

Bit(s) 8-inch Drive Shoe

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	7/16	9:10	7/22	18:45
Geophys. Logging:	-	-	-	-
Casing:	7/23	10:20	7/23	11:05
Filter Placement:	7/23	11:06	7/23	11:35
Cementing:	7/25	9:45	7/25	12:00
Development:				
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	
0	90	C1
-2.5	96	C2
96	106	S1

Casing: C1 8-inch Steel

C2 4-inch Type 304 Stainless Steel

Screen: S1 4-inch Type 304 .010 Slot Stainless Steel

S2

Centralizers None

Filter Material (6) 50-pound bags of No. 1 Sand

Cement (2½) batches (113 Gals.) Portland Type II Cement

Other (1) 5-gallon bucket Bentonite Pellets

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: R-10 OWNER:

LOCATION: Price Bros. Near Newman Creek ADDRESS:

TOTAL DEPTH: 106.3 feet

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: Cable Tool DATE DRILLED: 7/16/91

DRILLER: HELPER: Bill Kessler

LOG BY: Lyndy Lawlor, Dave Cairns

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-10			b		Brown clayey SILT with a little fine sand, and a trace to a little peat, moist, also a trace organic material.
10-12			SS		Brown GRAVEL with some sand and clay and a little silt, very poorly sorted, clay is gray to brown, gravel is rounded, saturated.
12-20			b		Brown GRAVEL with some sand and a little clay and silt, gravel is well rounded.
20-22			SS		NO RECOVERY
22-30			b		Gray CLAY, FINE SAND, with a trace gravel.
30-32			SS		0.15 feet gray-brown fine SAND, well sorted saturated, good water producing zone, a little silt and a trace clay. 1.5-1.6 feet gray brown fine to coarse SAND, poorly sorted, well rounded, with a trace silt and clay
32-35			b		Gray fine to medium SAND with a little silt and clay, no coarse gravel in bailer.
35-37			SS		Gray fine to coarse SAND with some gravel and silt and a trace clay. Clay on bottom of bit at 38 feet BGS.
37-40			b		Gray fine to medium SAND with a little silt and clay, no coarse gravel in bailer.
40-42			SS		SAME AS ABOVE with a little higher percent of gravel.
42-50			b		SAME AS ABOVE

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER. R-10 OWNER:

LOCATION: Price Bros. Near Newman Creek ADDRESS:

TOTAL DEPTH 106.3 feet

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: Cable Tool DATE DRILLED: 7/16/91

DRILLER: HELPER: Bill Kessler

LOG BY: Lyndy Lawlor, Dave Cairns

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
50-52					Gray CLAY, some gravel, with a little sand, moderately plastic, slightly moist, poorly sorted, firm.
52-58		b			Brown SAND and SILT with some clay and trace gravel.
58-60		SS			Gray-brown fine to medium SAND with some gravel and a little clay and silt, moderately well sorted, well rounded.
60-65		b			Brown fine to medium SAND, with some sandstone, a little gray clay and a trace silt.
65-70		b			SAME AS ABOVE
70-72		SS			Light brown weathered SANDSTONE with some clay in fractured weathered zones also some sand.
72-80		b			SAME AS ABOVE
78-80		b			SAME AS ABOVE
80-82		SS			Light brown CLAY and red-orange SANDSTONE fragments up to 1/2-inch in diameter, with some light gray sandstone fragments and trace clay.
82-85		b			SAME AS ABOVE
85-87		SS			Light gray SANDSTONE, friable, dry.
87-90		b			SAME AS ABOVE
90-98		b			SAME AS ABOVE, with some water.
98-106		b			Brown SANDSTONE, zone is producing water.
					E.O.B = 106.3 feet

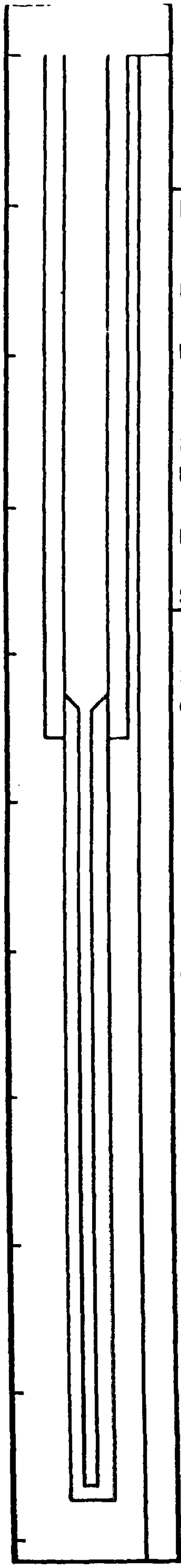
* A.S.T.M. D1586

SHEET 2 OF 2

Project EKCO Housewares, Inc.

Location Massillon, Ohio

Personnel Dave Cairns



Well R-12

Well Construction Summary

Location or Coords: 6689.567 N
5859.974 E

Elevation: Ground Level 943.0
Top of Casing 945.83

Drilling Summary:

Total Depth 108.5 feet BGS
Borehole Diameter 8-inches

Driller Bowser-Morner, Inc.

Rig Cable Tool
Bit(s) 8-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	7/3	8:30	7/9	18:20
Geophys. Logging:	--	--	--	--
Casing:	7/10	7:10	7/10	8:25
Filter Placement:	7/10	8:25	7/10	8:55
Cementing:				
Development:				
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	
0	69	C1
-2.5	88	C2
88	108	S1

Casing: C1 8-inch steel

C2 4-inch Stainless Steel
Type 304

Screen: S1 4-inch Stainless Steel
.010 slot, Type 304

S2

Centralizers None

Filter Material (13) 50-pound bags of No. 1
Sand

Cement (8) batches (45 gals.)
Portland Type II Cement

Other (1) 5 gal. bucket
Bentonite Pellets

Well Development:

Grundfus Pump

Comments:

WESTON DESIGNERS CONSULTANTS

ROY F. WESTON INC
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

SKETCH MAP

NOTES:

WELL NUMBER: R-12
OWNER:
LOCATION: Price Bros.
ADDRESS:
TOTAL DEPTH: 108 feet BGS
SURFACE ELEVATION: 943.0
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable tool
DATE DRILLED: 7/2/91
DRILLER:
HELPER: Bill Kessler
LOG BY: Dave Cairns

b = bailer sample
SS = split spoon sample

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-28					See drilling log of S-12 for lithologic description of the interval 0-28 feet BGS for I-12.
28-36			b		SAME AS ABOVE
36-37			SS		Gray CLAY with some pebbles, sand and a little silt, predominantly plastic, poorly sorted, slightly moist to moist. Clay - 50%, pebbles - 20%, sand (fine to coarse) 20%, silt - 10%. Just on top of the clay is a poorly sorted sand (fine to very coarse) with a little silt and small gravel.
37-39			b		SAME AS ABOVE
39-41			SS		Gray GRAVEL AND SAND with a little (15%) silt, trace clay saturated poorly sorted, gravel is angular. Thin bed (.04') of brown sand, fine grained well sorted.
41-54			b		GRAVEL AND SAND
54-56			SS		GRAVEL AND SAND, gray color due to silt and clay in matrix, 50% gravel, 35% sand, poor recovery. Piece of gravel stuck in shoe of spoon.
56-65			b		SAME AS ABOVE
65-66.2			SS		Gray CLAY with a little fine sand and silt, dense slightly plastic, thinly bedded, slightly moist.

* A.S.T.M. D1586

ROY F. WESTON INC.

WESTON

DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: R-12

OWNER:

LOCATION: Price Bros.

ADDRESS:

TOTAL DEPTH: 108 feet BGS

SURFACE ELEVATION: 943.0

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: Cable Tool

DATE DRILLED: 7/2/91

DRILLER:

HELPER: Bill Kessler

LOG BY: Dave Cairns

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
66.2			SS		Gray-white SANDSTONE (BEDROCK CONTACT) fine, well sorted, competent, platey thin beds apparent.
66.2-71					SAME AS ABOVE
71-71.9					Interbedded gray-white SANDSTONE and gray SHALE; predominantly sandstone, friable but more competent than the shale; the shale has 20% fine grained sand in matrix. Thinly bedded, dry to slightly moist, trace of Fe staining in sandstone.
72-78			b		Predominantly gray SHALE, thinly bedded, competent, some breaks, some doesn't; sand gray-white sandstone interbedded, fine grained well sorted, competent. Shale is platy and has 25% fine sand and silt in matrix.
78-88			b		Gray-brown SANDSTONE, some cuttings are brown, poorly sorted (fine to coarse), some surfaces weathered, some
88-100			b		Brown SANDSTONE (fine), trace (5%) of silt well sorted/rounded. Could possibly be getting into a gray sandstone, change of color in bottom of bailer.
100-105			b		Brown SANDSTONE (fine to medium), trace coarse sand and trace silt, moderately sorted. Not as well sorted or as fine as previous interval. Predominantly quartz sand with a trace black sand.

* A.S.T.M. D1586

ROY F. WESTON INC.
WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: R-12

OWNER:

LOCATION: Price Bros.

ADDRESS:

TOTAL DEPTH: 108 feet BGS

SURFACE ELEVATION: 943.0

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: Cable Tool

DATE DRILLED: 7/2/91

DRILLER:

HELPER: Bill Kessler

LOG BY: Dave Cairns

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
105-108.5		b			Brown SANDSTONE (fine to medium), trace (5%) silt and coarse sand, moderately sorted, a little better thanprevious interval, predominantly quartz sand with a trace of very fine to fine black sand.
					E.O.B = 108.5 feet BGS

* A.S.T.M. D1586

SHEET 3 OF 3

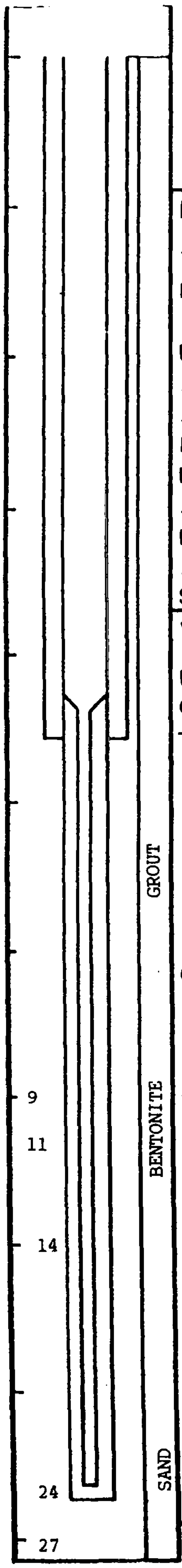
Well S-4

Well Construction Summary

Project: EKCO Housewares, Inc.

Location: Massillon, Ohio

Personnel: Thomas Cornuet



Location or Coords: 6034.764 N
5930.724 E

Elevation: Ground Level 932.3

Top of Casing 935.17

Drilling Summary:

Total Depth 27 feet

Borehole Diameter 8 inches

Driller Bowser-Morner

Rig Cable Tool

Bit(s) 8-inch (E.D.) Drive Casing
9.5-inch (O.D.) Drive Shoe

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

From	To	String
-2.5	14	C1
14	24	S1

Casing: C1 4-inch Stainless Steel
Type 304

C2

Screen: S1 4-inch Stainless Steel
.010 slot, Type 304

S2

Centralizers None

Filter Material (9) 50-pound bags of No. 1 sand

Cement (1) batch (45 gals.) Portland Type II Cement

Other (1) 5 gallon bucket Bentonite Pellets

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:				
- -	8/10	13:15	8/11	09:30
Geophys. Logging:	--	--	--	--
Casing:				
	8/11	09:30	8/11	10:46
Filter Placement:	8/11	10:46	8/11	12:20
Cementing:	8/11	13:20	8/11	15:30
Development:				
Other:				

Well Development:

Grundfus Pump

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: S-4

LOCATION: Adjacent to I-4 and R-4

SURFACE ELEVATION: 923.3

OWNER:

ADDRESS:

TOTAL DEPTH: 27 feet

WATER LEVEL: 15 feet

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: Cable Tool

DATE DRILLED: 8/10/91

DRILLER:

HELPER: Bill Kessler

LOG BY: Tom Cornuet

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-5			b		Dark brown CLAY with some medium to coarse sand, poorly sorted, dry to slightly moist, a few cobbles 3 to 6 inches in diameter, some fill, OVA = background.
5-7			SS		SAME AS ABOVE, fairly stiff, dry to slightly moist, OVA background, 50% recovery.
7-10			b		SAME AS ABOVE with more coarse sand.
10-12			SS		Light brown coarse SAND, poorly sorted, with some fine gravel and pieces of larger cobbles. Gravel is angular, friable, a little clay, moist but may be drilling water, OVA = background, 50% recovery.
12-15			b		SAME AS ABOVE
15-17			SS		Top 8 inches: Coarse SAND with some fine gravel and a little clay, fairly stiff, poorly sorted, not much water; bottom 4 inches: fine to medium brown SAND, well sorted, moist, fair amount of water, OVA = background, 60% recovery.
17-20			b		SAME AS (bottom 4 inches) ABOVE, with increasing amount of clay.
20-22			SS		Brown CLAY with some fine to coarse sand and a trace fine gravel, poorly sorted, soft to firm, OVA = background.
22-25			b		SAME AS ABOVE

* A.S.T.M. D1586

ROY F. WESTON, INC.

WESTON

DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: S-4

OWNER:

LOCATION: Adjacent to I-4 and R-4

ADDRESS:

TOTAL DEPTH 27 feet

SURFACE ELEVATION: 923.3

WATER LEVEL: 15 feet

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: Cable Tool

DATE DRILLED: 8/10/91

DRILLER:

HELPER: Bill Kessler

LOG BY: Tom Cornuet

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
25-27					SAME AS ABOVE
					NOTE: 20 to 27' zone has fairly low permeability but is somewhat soft and moist. I-4 log indicates that CLAY continues to 42 feet.
					E.O. B = 27 feet

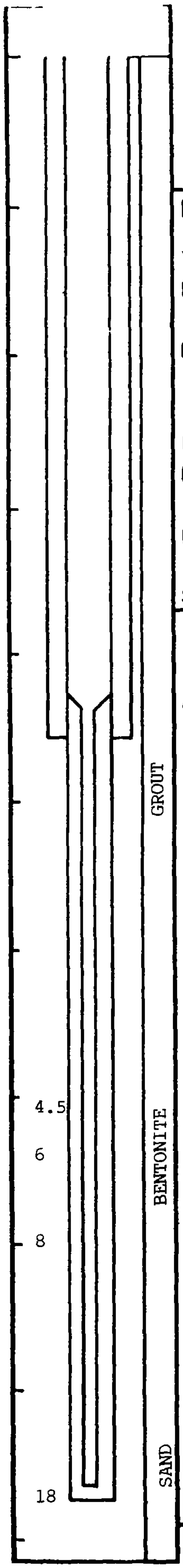
* A.S.T.M. D1586

SHEET 2 OF 2

Location Massillon, Ohio

Personnel Pat Doran

Project EKCO Housewares, Inc.



Well S-11

Well Construction Summary

Location or Coords: 6464.544 N
6289.611 E

Elevation: Ground Level 931.7

Top of Casing 934.52

Drilling Summary:

Total Depth 18 feet

Borehole Diameter 8 inches

Driller Bowser-Morner, Inc.

Rig Cable Tool

Bit(s) 8-inch

Drilling Fluid Potable Water

Surface Casing

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	6/25	11:45	6/24	15:35
Geophys. Logging:	--	--	--	--
Casing:	6/24	15:35	6/24	16:00
Filter Placement:	6/24	16:00	6/24	16:45
Cementing:	6/24	NA	6/24	NA
Development:	7/15	15:30	7/15	17:15
Other:				

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

-2.5 - 8	C1	
8 - 18	S1	

Casing: C1 4-inch Stainless Steel
Type 304

C2

Screen: S1 4-inch Stainless Steel
.010 Slot Type 304

S2

Centralizers None

Filter Material (10.5) 50-pound bags of No. 1 Sand

Cement (1) batch (45 gals) Portland Type II Cement

Other (1) 5 gal. bucket Bentonite Pellets

Well Development:

Grundfus Pump

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: S-11
OWNER:
LOCATION:
ADDRESS:
TOTAL DEPTH 17 feet
SURFACE ELEVATION: 931.7
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED: 6/24/91
DRILLER:
HELPER: Bill Kessler
LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-2			SS		Miscellaneous debris, FILL
2-5			b		SAME AS ABOVE
5-7			SS		Dark grayish brown SILT, trace to little clay.
7-10			b		SAME AS ABOVE
10-12			SS		Dark brown well sorted SAND AND GRAVEL with some silt and clay, damp to wet.
12-15			b		SAME AS ABOVE
15-17			SS		Dark brownish-gray SAND AND GRAVEL, with some silt, damp to wet.
15-17			b		SAME AS ABOVE
					E.O.B. = 18 feet

* A.S.T.M. D1586

SHEET ___ OF ___

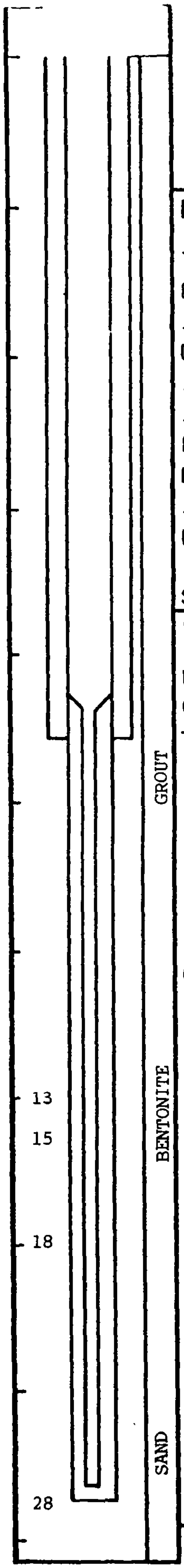
Well S-12

Well Construction Summary

Location or Coords: 6688.864 N
5876.864 E

Elevation: Ground Level 942.1
Top of Casing 945.26

Location Massillon, Ohio
Personnel Pat Doran
Project EKCO Housewares, Inc.



Drilling Summary:

Total Depth 28 feet
Borehole Diameter 8 inches

Driller Bowser-Morner, Inc.

Rig Cable Tool
Bit(s) 8-inch

Drilling Fluid Potable Water

Surface Casing 8-inch

Well Design:

Basis: Geologic Log Y Geophysical Log N

Casing String(s): C = Casing S = Screen

-2.5 - 18	C1	
18 - 28	S1	

Casing: C1 4-inch Stainless Steel
Type 304

C2

Screen: S1 4-inch Stainless Steel
.010 Slot Type 304

S2

Centralizers None

Filter Material (8) 50-pound bags of
No. 1 Sand

Cement (2) batches (45 gals.)
Portlant Type II Cement

Other (1) 5-gallon bucket
Bentonite Pellets

Construction Time Log:

Task	Start 1991 Date	Start Time	Finish 1991 Date	Finish Time
Drilling:	7/2	8:00	7/2	14:05
Geophys. Logging:	--	--	--	--
Casing:	7/2	14:05	7/2	15:00
Filter Placement:	7/2	15:00	7/2	15:30
Cementing:	7/2	15:30	7/2	17:30
Development:				
Other:				

Well Development:

Grundfus Pump

Comments:

Master Lock No. 2035

WESTON
DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: S-12
OWNER:
LOCATION:
ADDRESS:
TOTAL DEPTH
SURFACE ELEVATION: 942.1
WATER LEVEL: 28 feet
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: Cable Tool
DATE DRILLED:
DRILLER:
HELPER: Bill Kessler
LOG BY: Pat Doran

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0-5			b		Light gray SAND AND GRAVEL with a little silt, trace cement fragments (fill).
5-7			SS		Dark gray-brown SILT AND GRAVEL with same coarse sand, very stiff.
7-8			b		SAME AS ABOVE
8-17			b		Orange-brown fine to coarse SAND AND GRAVEL with a trace silt.
17-19			SS		Dark brown fine to coarse SAND with a little silt and a trace gravel.
19-27.5			b		SAME AS ABOVE
27.5-28			b		SAME AS ABOVE with larger cobbles.
					E.O.B. = 28 feet

* A.S.T.M. D1586

SHEET ____ OF ____

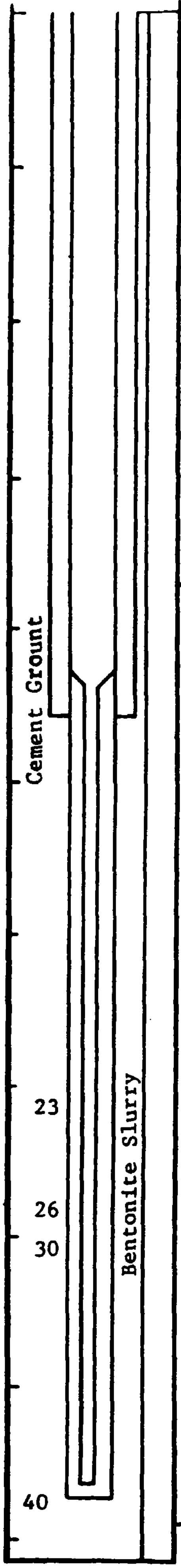
Well Construction Summary

Well I-2

Location EKCO Massillon OH

Personnel L. Sherrerd Steele

Project American Home Products



Location or Coords: 10' northwest of R-2 Elevation: Ground Level

Top of Casing

Drilling Summary:

Total Depth 40'

Borehole Diameter 8"

Driller Bowser-Morner
Jeff Riddle

Rig Cable Tool

Bit(s) 7 5/8"

Drilling Fluid Potable H2O

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C=Casing S=Screen

C	-	30	+2
S	-	40	30

Casing: C1 4" Low Carbon Steel

C2 N/A

Screen: S1 4" Stainless steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural Sand Pack from bottom to 26' BGS

Cement Portland, Type I, from top of seal to surface

Other Seal: Bentonite slurry from top of sand to 23' BGS
- Protective Casing

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 7 5/8"	6/28/88	1025	6/28/88	1125
Geophys. Logging:				
Casing/Screen 4'	6/29/88	0835	6/29/88	0920
Filter Placement:				
Cementing:	6/29	1100	6/29	1205
Development:				
Other: Seal	6/29/88	1045	6/29/88	1050

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: I-2

LOCATION: 10' NW of R-2
Massillon OH

SURFACE ELEVATION:

DRILLING COMPANY: Bowser-Morner

DRILLER: Jeff Riddle

LOG BY: S. Steele

OWNER:

ADDRESS:

TOTAL DEPTH 40'

WATER LEVEL:

DRILLING METHOD:

DATE DRILLED: 6/28/88

HELPER: Bill Young

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5'-7'	1			Dark brown clayey sand and gravel in a clayey silt matrix; little or no cohesion; gravel is subangular; poorly sorted
10	10'-12'	2			Black gravel with some medium sand, silt, construction rubble; moist, poorly sorted
	15'-17'	3			Grey, gravel, poorly sorted, some silty clay; dry- fill
20	20'-22'	4			Yellow-brown, fine to medium sand with some gravel (subangular) and trace silt; dry, poorly sorted
	25'-27'	5			Light brown to brown, fine to medium sand and gravel (subrounded to subangular) few fines; large cobble near end of spoon; at tip, a small clay lense, gray, slightly cohesive-wet
30	30'-32'	6			Gray, fine to medium sand matrix with gravel and cobbles, few fines; poorly sorted; moist
	35'-37'	7			As above, except sample is wet and bottom 2" is yellow-brown fine sandy silt; well sorted
40					

* A.S.T.M. D1586

SHEET 1 OF 2

WESTON

DRILLING LOG

WELL NUMBER: I-2 OWNER:

LOCATION: 10' NW of R-2 ADDRESS:

Massillon OH

TOTAL DEPTH 40'

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: DATE DRILLED: 6/28/88

DRILLER: Jeff Riddle HELPER: Bill Young

LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40	40'-42'	8			As above (30'-32') in top 2"; bottom 8" is a fine sandy silt, yellow-brown to orange-brown; in bottom of spoon is rock - weathered sandstone - well bedded; brittle

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: I-3
OWNER:
LOCATION: 10' south of R-3
ADDRESS:
TOTAL DEPTH 32'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD:
DATE DRILLED: 7/12/88
DRILLER: Jeff Riddle
HELPER: Bill Young
LOG BY: S. Steele

SKETCH MAP

NOTES: No well was installed at this location

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5'-7'	1			Top 7"-fill consisting of cinders, gravel, sandstone cobbles, clay and some dark brown to black sand; bottom 9"-olive green sandy clay, slightly cohesive; moist
10	10'-12'	2			Top 11"-As above with gravel-diameter ½-1"; bottom 6"-pinkish brown sand with gravel (appears to be sandstone gravel; poorly sorted, dry
	15'-17'	3			Pinkish-brown coarse sandy clay, grades into a pinkish-brown to tan medium to coarse sand-1-2" diameter gravel; dry
20	20'-22'	4			Top 8"-coarse sand and gravel with trace clay; bottom 8"-medium sand with some orange-brown silt; moist
	25'-27'	5			Yellowish-tan medium sand with some angular gravel-1" diameter dry
30	30'-32'	6			Brown sandy silty clay, dry and cohesive; at 31' bedrock was was hit-yellow brown sandstone
40					

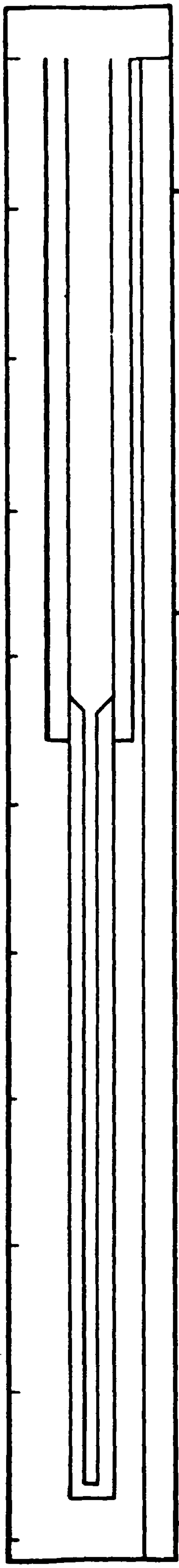
* A.S.T.M. D1586

SHEET 1 OF 1

Location Ekco, Massillon, OH

Personnel L. Sherrerd Steele

Project American Home Products



Well I-4

Well Construction Summary

Location or Coords: Adjacent to Site Well R-4

Elevation: Ground Level 932.36

Top of Casing 933.17

Drilling Summary:

Total Depth 72.5'

Borehole Diameter 8"

Driller Bowser-Morner, S.E. Patterson

Rig Cable tool rig

Bit(s) N/A

Drilling Fluid Potable water

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ___

Casing String(s): C = Casing S = Screen

C	-	62.5	+2
S	-	72.5	62.5

Casing: C1 4" Low carbon steel

C2 N/A

Screen: S1 4" Stainless steel, type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from the bottom to 58' BGS

Cement Portland, Type I from 53' BGS to the surface.

Other o Seal: Bentonite slurry from top of sand to 53'BGS

o Protective casing

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	6/1	0900	6/1	1645
Geophys. Logging:				
Casing:/Screen: 4"	6/2	0930	6/2	1100
Filter Placement:				
Cementing:	6/2	1120	6/2	1600
Development:	6/28	1000	6/28	1215
Other: SEAL	6/2	1100	6/2	1120

Well Development:

Very silty at first then cleared up. Developed by air lifting and well produced 5-6 gpm.

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: I-4
OWNER:
LOCATION: State Street Ext. Massillon, OH Next to R-4
ADDRESS:
TOTAL DEPTH 72.5'
SURFACE ELEVATION: 932.36'
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 6/1/88
DRILLER: S.C. Patterson
HELPER: Joe Patterson
LOG BY: L. Sherrerd Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5-7	1	SS	-	Silty clay, brown to orange brown, moist cohesive, intermixed with some medium sand and fine gravel, poorly sorted.
10	10-12	2	SS	-	Sandy silt, brown to orange brown intermixed with medium sand, cobbles and gravels (up to 2" in diameter), cinders, white granular material, very poorly sorted, wet.
	13-15	3	SS	-	Cobbles in a fine silty sand matrix grading into a fine clayey sand and back into a silty sand, well sorted, stratified, dark orange brown, wet.
	18-20	4	SS	-	Silty clay, medium brown, very loose with large gravel (up to 2" in diameter), subrounded to subangular and with medium sand, poorly sorted, wet.
20					
	23-25	5	SS	-	No recovery.
	28-30	6	SS	-	Clay, light to medium grey, cohesive, intermixed with medium-coarse sand and some gravels, poorly sorted, wet.
30					
	33-35	7	SS	-	As above but with fewer sand and gravel.
	38-40	8	SS	-	As above.
40					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: I-4	OWNER:
LOCATION: State Street Ext. Massillon, OH Next to R-4	ADDRESS:
	TOTAL DEPTH 72.5'
SURFACE ELEVATION: 932.36'	WATER LEVEL:
DRILLING COMPANY: Bowser-Morner	DRILLING METHOD: HSA
DATE DRILLED: 6/1/88	
DRILLER: S.C. Patterson	HELPER: Joe Patterson
LOG BY: L. Sherrerd Steele	

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40					
	43-45	9	SS	-	Gravel, light grey to grey, somewhat uniform, subangular, ¼"-1" diameter, with sand, medium to coarse, in a clay matrix, wet, poorly sorted.
50	48-50	10	SS	-	Gravel, light grey to grey, subrounded to rounded (¼"-1" in diameter) in a fine to coarse sand matrix, trace silt, poorly sorted. Some larger cobbles (2" diameter) towards end of sample, wet.
					55'-72.5': (No Split Spoon samples taken between these depths because material too large for the Spoon. The following lithology was described from bailer cuttings.) Large (2"-4" diameter rounded cobbles in a matrix of coarse sand and gravel.
60					
70					
					72.5': Bedrock.
80					

* A.S.T.M. D1586

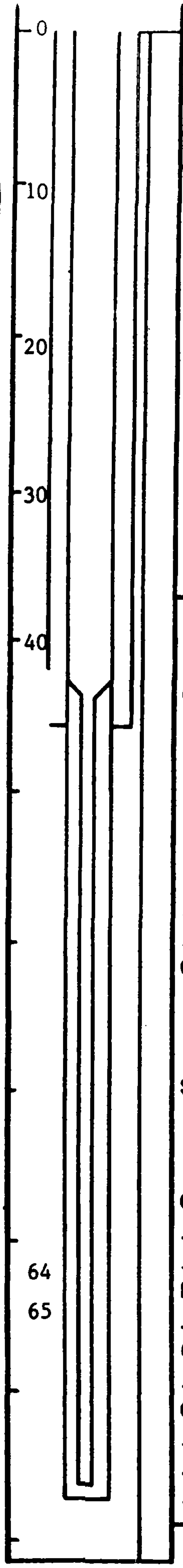
Well Construction Summary

Well I-5

Location EKCO Massillon OH

Personnel L. Sherrerd Steele

Project American Home Products



Location or Coords: ______

Elevation: Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 64'

Borehole Diameter 8"

Driller Bowser-Morner

Rig ______

Bit(s) Cable Tool

Drilling Fluid ______

Surface Casing Low Carbon Steel

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
0-22'	6/29	1620	6/29	1820
22-67'	6/30	825	6/30	1440
Geophys. Logging:				
Casing:				
	7/5	1430	7/5	1935
Filter Placement:	7/5	1430	7/5	1615
Cementing:	7/5	1615	7/5	1930
Development:	7/10	1320	7/10	1459
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C = Casing S = Screen

Casing: C1 4" Low Carbon Steel (54 ft.)

C2 ______

Screen: S1 4" Stainless Steel Screen (10 ft.)

S2 ______

Centralizers ______

Filter Material Bentonite Slurry

Cement ______

Other ______

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-5
OWNER:
LOCATION: 10' north of W-2
ADDRESS:
TOTAL DEPTH 65'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD:
DATE DRILLED: 6/30/88
DRILLER: Jeff Riddle
HELPER: Bill Young
LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5'-7'	1			Fill material, construction rubble (bricks), cinders, gravel, cobbles; at end of spoon is 3" clay lense, intermixed with some gravel and silt (yellow-brown)
10	10'-12'	2			Fill, red-brown, silt matrix with gravel, cinders, some brick fragments and small clay lenses
	15'-17'	3			Fill material, yellow-brown to orange-brown silt, clay, gravel and medium sand; poorly sorted, dry
20	20'-22'	4			Tan to brown medium sand intermixed with rounded to sub-rounded cobbles; poorly sorted, moist
	25'-27'	5			As above, with trace silt
30	30'-32'	6			Tan to brown medium sand intermixed with some rounded to sub-rounded cobbles (less than samples above), poorly sorted, moist
	35'-37'	7			Grey to dark grey medium sand with subrounded cobbles and gravel with some clay; poorly sorted, moist
40					

* A.S.T.M. D1586

SHEET 1 OF 2

DRILLING LOG

WELL NUMBER: I-5 OWNER:

LOCATION: ADDRESS:

TOTAL DEPTH 65'

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: DATE DRILLED 6/30/88

DRILLER: Jeff Riddle HELPER: Bill Young

LOG BY: S. Steele

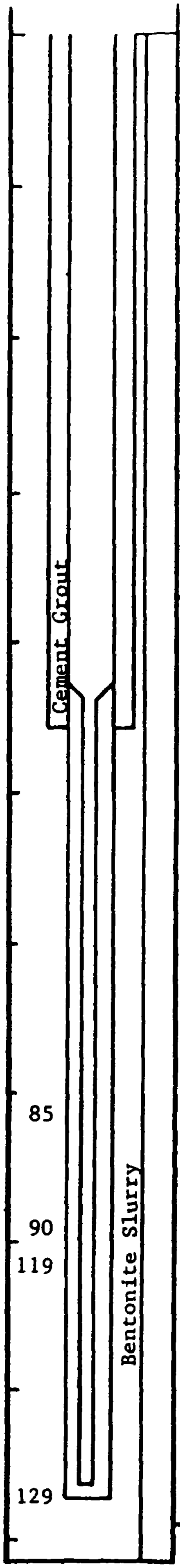
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40	40'-42	8			As above, but saturated with less clay
	45'-47	9			As above, but more gravel (rounded to subrounded and smaller in diameter); gravel is the predominant constituent
50	50'-52	10			Dark grey medium to coarse sand intermixed with some cobbles (well rounded); well sorted, saturated
	55'-57'	11			As above but some clay intermixed towards end of spoon; HNU reading: 0-3 ppm
60	60'-62'	12			As above, but no clay, fewer gravels; sand becomes finer towards bottom of spoon
	65'-67'	13			Brown weathered, brittle sandstone
70					

* A.S.T.M. D1586

Project American Home Products
Location EKCO Massillon OH
Personnel L. Sherrerd Steele



Well Construction Summary

Well I-6

Location or Coords: ______

Elevation: Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 130'
Borehole Diameter 8"

Driller Bowser-Morner
Jeff Riddle

Rig Cable Tool
Bit(s) 7 5/8"

Drilling Fluid Potable H20

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ______
Casing String(s): C=Casing S=Screen

C	120	+2
S	130	120

Casing: C1 4" Low Carbon Steel

C2 N/A

Screen: S1 4" Stainless Steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from bottom to 90' BGS

Cement Portland, Type I from top of seal to surface

Other Seal: Bentonite slurry from top of sand to 85' BGS
- protective casing

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:	7/6/88	1055	7/8/88	1715
Geophys. Logging:				
Casing:/Screen 4"	7/10/88	0815	7/10/88	0920
Filter Placement:				
Cementing:	7/11	935	7/11	1100
Development:	7/14	1000	7/14	1100
Other: Seal	7/11/88	925	7/11/88	935

Well Development:

Purged well for 1 hour at a rate of between 10-15 gpm. Water was crystal clear.

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: I-6

OWNER:

LOCATION: 70' north of State St. across from Ohio Packaging Corp.

ADDRESS:

TOTAL DEPTH 130'

SURFACE ELEVATION: -

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD:

DATE DRILLED: 7/9/88

DRILLER: Jeff Riddle

HELPER: Bill Young

LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5'-7'	1			Medium sand and gravel, some cobbles with glass shards, brick fragments and trace clay; fill materials, black
10	10'-12'	2			Grey to dark grey clay with organic material throughout; cohesive, towards end of sppon sand content increases to a sandy clay intermixed with trace gravel
	15'-17'	3			Yellow-brown to brown sandy clay intermixed with gravel (subrounded); poorly sorted, moist
20	20'-22'	4			Gravel (subrounded to rounded) with yellow-brown medium to coarse sand and some clay in matrix; poorly sorted
	25'-27'	5			Grey to light grey medium to coarse sand, gravel (subrounded to rounded) and some clay; poorly sorted
30	30'-32'	6			Grey to dark grey medium sand with gravel and clay lenses gravel rounded to subrounded; at end of spoon is 3" clay silt layer (grey to dark grey)
	35'-37'	7			Grey fine to medium sand with some rounded to subrounded gravel; sand is well sorted
40					

* A.S.T.M. D1586

DRILLING LOG

WELL NUMBER: I-6
OWNER:
LOCATION: 70' north of State St. across from Ohio Packaging Corp.
ADDRESS:
TOTAL DEPTH 130'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY Bowser-Morner
DRILLING METHOD:
DATE DRILLED: 7/9/88
DRILLER: Jeff Riddle
HELPER: Bill Young
LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40	40'-42'	8			Grey medium sand with some small rounded to subrounded cobbles and trace silt; sand is well sorted
	45'-47'	9			As above, but sand grades into fine sand at bottom; saturated
50	50'-52'	10			Brownish-grey fine to medium sand (well sorted); no cobbles present; saturated
	55'-57'	11			As above
60	60'-62'	12			As above, except increasing content of gravel
	65'-67'	13			As above
70	70'-72'	14			Stratified greyish brown medium sand, gravel and clay
	75'-77'	15			As above except more gravel
80					

* A.S.T.M. D1586

DRILLING LOG

WELL NUMBER: I-6 OWNER:

LOCATION: 70' north of State St. across from Ohio Packaging Corp. ADDRESS:

TOTAL DEPTH 130'

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY Bowser-Morner DRILLING METHOD: DATE DRILLED: 7/9/88

DRILLER: Jeff Riddle HELPER: Bill Young

LOG BY: S. Steele

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
80	80'-82'	16			Cuttings taken from spoon are 4-6" diameter cobbles and medium to coarse sand; possible some traces of clay
	85'-87'	17			Grey medium to coarse sand with gravel and cobbles; trace clay; gravel 1½-1" diameter
90	90'-92'	18			As above
	95'-97'	19			As above
100	100'-102'	20			As above
	105'-107'	21			As above
110	110'-112'	22			Fine sand and gravel; well sorted grading into gravel ¼-½" diameter and coarse sand; stratified
	115'-117'	23			Grey medium sand and gravel; trace clay
120					

* A.S.T.M. D1586

SHEET 3 OF 4

DRILLING LOG

WELL NUMBER: I-6
OWNER:
LOCATION: 70' north of State St. across from Ohio Packaging Corp.
ADDRESS:
TOTAL DEPTH 130'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD:
DATE DRILLED: 7/9/88
DRILLER: Jeff Riddle
HELPER: Bill Young
LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
120	120'-122'	24			As above
	125'-127'	25			As above
130	130'-132'	26			As above, first 3"; bottom 7" is a blue-grey shale, platey; somewhat weathered

* A.S.T.M. D1586

SHEET 4 OF 4

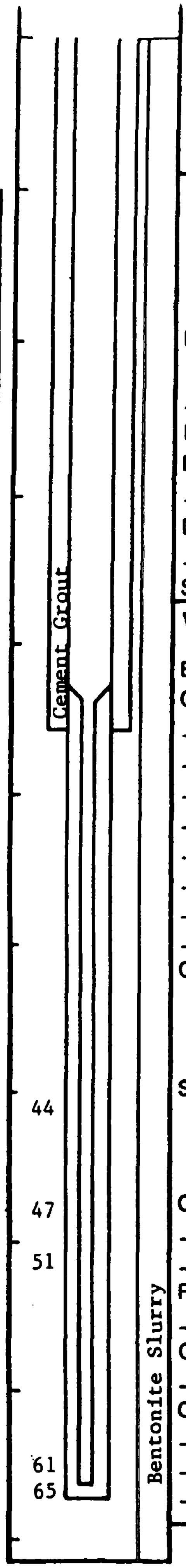
Well I-7

Well Construction Summary

Project: American Home Products

Location: EKCO Massillon OH

Personnel: L. Sherrerd Steele



Location or Coords: 20' east of RR and 600' north of State Street

Elevation: Ground Level ____

Top of Casing ____

Drilling Summary:

Total Depth: 65'

Borehole Diameter: 8"

Driller: Bowser-Morner, Jeff Riddle

Rig: Cable Tool

Bit(s): 7 5/8"

Drilling Fluid: Potable H20

Surface Casing: ____

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 7 5/8"	7/12/88	1345	7/13/88	1050
Geophys. Logging:				
Casing:/Screen 4"	7/13/88	1050	7/13/88	1105
Filter Placement:				
Cementing:	7/13	1500	7/13	1550
Development:	7/23	1100	7/23	1130
Other: Seal	7/13/88	1450	7/13/88	1452

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C	-	51	+2
S	-	61	51

Casing: C1 4" Low Carbon Steel

C2 N/A

Screen: S1 4" Stainless Steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from bottom to 47' BGS

Cement Portland, Type I from top of seal to surface

Other Seal: Bentonite slurry from top of sand to 44' BGS
- Protective Casing

Well Development:

Purged well ofr ½ hour at a rate of 15 gpm. Water was very clear.

Comments:

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-7

OWNER:

LOCATION: 20' east of RR and 600' north of State Street

ADDRESS:

TOTAL DEPTH 65'

SURFACE ELEVATION:

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD:

DATE DRILLED: 7/13/88

DRILLER: Jeff Riddle

HELPER: Bill Young

LOG BY: S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5'-7'	1			Fill material-broken bricks, iridescent cinders, silty clay wood fragments, sand-like materials
10	10'-12'	2			Top 3" - dark brown clayey gravel; bottom 11" - reddish-brown sandy clay grading into a reddish-brown clayey sand, poorly sorted with some gravel (subangular), trace silt
	15'-17'	3			Top 4" - yellow to light brown medium sand, well sorted, dry bottom 1" - somewhat hard, reddish brown sandstone, dry
20	20'-22'	4			Brown gravel with sandy clay - most probably plug material; wet
	25'-27'	5			Gravel and broken cobbles in a yellow-brown sand and clay matrix; appears to be wet (may be due to drilling fluids); poorly sorted
30	30'-32'	6			Yellow-brown coarse sand and cobbles in a clay matrix, not cohesive; poorly sorted; appears to be wet
40					

* A.S.T.M. D1586

SHEET 1 OF 2

SKETCH MAP

DRILLING LOG

WELL NUMBER: I-7

OWNER:

LOCATION: 20' east of RR and 600' north of State Street

ADDRESS:

TOTAL DEPTH 65'

SURFACE ELEVATION:

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD:

DATE DRILLED: 7/13/88

DRILLER: Jeff Riddle

HELPER: Bill Young

LOG BY: S. Steele

NOTES:

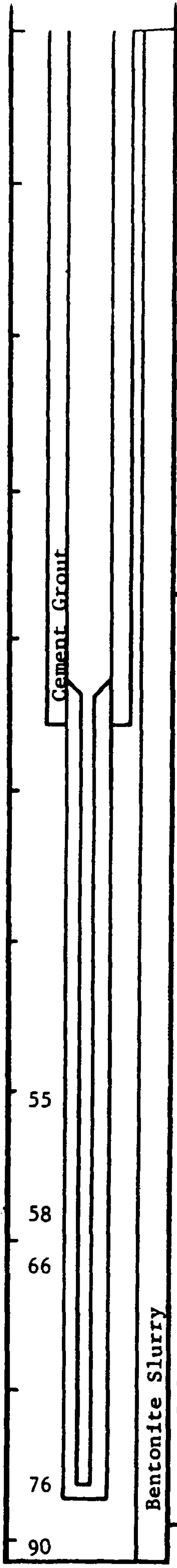
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS *	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40	40'-42'	7			Large cobbles in grey coarse sand and clay matrix; appears to be saturated
	45'-47'	8			Grey medium to coarse sand with gravel and cobbles; some clay
50	50'-52'	9			As above
	55'-57'	10			Stratified grey medium sand and gravel with clay - some layered
60	60'-62'	11			Top 6" medium sand and gravel; bottom 4" yellow-brown sandy clay and sandstone fragments
	65'-67'	12			Top 12" - same as above; bottom 6" - sandstone
70					
80					

* A.S.T.M. D1586

Project American Home Products

Location EKCO Massillon OH

Personnel L. Sherrerd Steele



Well Construction Summary

Well I-8

Location or Coords: 40' west of 3rd St. on Ohio Water Service Property

Elevation: Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 92'

Borehole Diameter 8"

Driller Bowser-Morner
Jeff Riddle

Rig Cable Tool

Bit(s) 7 5/8"

Drilling Fluid Potable H_2O

Surface Casing N/A

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 7 5/8"	7/20/88	0930	7/21/88	1445
Geophys. Logging:				
Casing:/Screen 4"	7/21	1600	7/21	1755
Filter Placement:				
Cementing:	7/22	0850	7/22	1020
Development:	7/23	1145	7/23	1245
Other: Seal	7/22	0810	7/22	0830

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C = Casing S = Screen

C	66	+2
S	76	66

Casing: C1 4" Low Carbon Steel with L.C. couplings

C2 N/A

Screen: S1 4" Stainless Steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from bottom to 58'

Cement Portland, Type I from top of seal to surface

Other Seal: Bentonite slurry from top of sand to 55' BGS
- Protective casing

Well Development:

Purged well for 1 hour at a rate of 15 gpm. Water was very clear.

Comments:

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: I-8
LOCATION: 40' west of 3rd St. on Ohio Water Service Property
SURFACE ELEVATION:
DRILLING COMPANY: Bowser-Morner
DRILLER: Jeff Riddle
LOG BY: L. Sherrerd Steele

OWNER:
ADDRESS:
TOTAL DEPTH 76'
WATER LEVEL:
DRILLING METHOD: CableTool
DATE DRILLED: 7/20/88-7/21/88
HELPER: Bill Young

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
					See Well Log for P-3 for Lithology
40					
	45'-47'	1			Fine to medium sand and subrounded to rounded gravel with some clay, poorly sorted; wet
50	50'-52'	2			Fine sand grey to medium grey, well sorted with some small gravel towards end of spoon; wet
	55'-57'	3			Gravel, subangular from ¼"-1" diameter in a fine sand and clay matrix; wet, grey, poorly sorted
60	60'-62'	4			Fine to medium sand, medium grey, well sorted with some small bebbles intermixed; wet
	65'-67'	5			As above
70					

* A.S.T.M. D1586

SKETCH MAP

DRILLING LOG

WELL NUMBER: I-8
OWNER:
LOCATION: 40' west of 3rd St. on Ohio Water Service Property
ADDRESS:
TOTAL DEPTH 76'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: CableTool
DATE DRILLED: 7/20/88-7/21/88
DRILLER: Jeff Riddle
HELPER: Bill Young
LOG BY: L. Sherrerd Steele

NOTES:

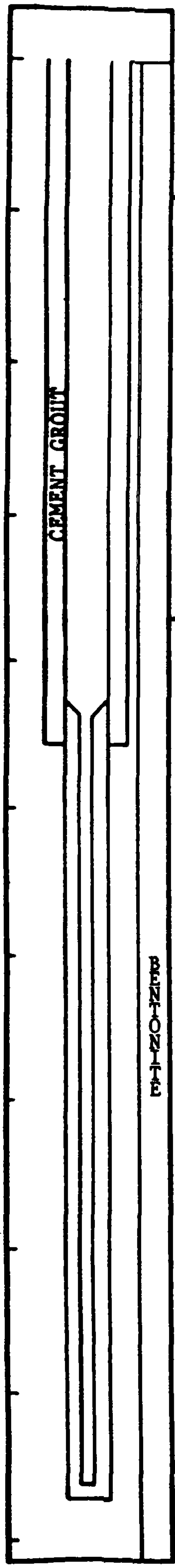
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
70	70'-72'	6			Top 1" as above; middle 3" sandy clay, lt. grey, loose with some gravel, angular; bottom 1" somewhat hard, with impressipons of shells, grey with some sandy clay
	75'-77'	7			No Recovery
	77'-80'				No Recovery - went through clay as reported by driller
80	80'-82'	8			Poor recovery, sand and gravel, fine sand and small ¼"-½" diameter, probably plug
	85'-87'	9			Coarse sand with fine sandy clay, poorly sorted, wet, grey
90	90'-92'	10			Top 3" loose, grey sandy clay; bottom 2" sandstone, yellow-brown
100					

* A.S.T.M. D1586

Project American Home Products

Location Massillon, OH

Personnel L. Sherrerd Steele



Well L-1

Well Construction Summary

Location or Coords: Southeast side of the lagoon

Elevation: Ground Level 944.76

Top of Casing 946.25

Drilling Summary:

Total Depth 40'

Borehole Diameter 8" O.D.

Driller Bowser-Morner, Joe Falbo

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid Potable water

Surface Casing N/A

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	5/25	1358	5/25	1650
Geophys. Logging:				
Casing/Screen: 4"	5/26	0825	5/26	0826
Filter Placement:	5/26	0830	5/26	0842
Cementing:	5/26	0910	5/26	1030
Development:	6/29	1015	6/29	1600
Other: SEAL	5/26	0900	5/26	0901

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C - 29.5 +2

S - 39.5 29.5

Casing: C1 4" ID Low Carbon Steel Riser

C2 N/A

Screen: S1 4" ID Stainless Steel, Type 304, 10'

S2 N/A

Centralizers N/A

Filter Material Sand, No. 2, 1.5' above top of screen

Cement Portland, Type I from 25' to surface

Other o Seal: Bentonite pellets, 3' above sand pack.
o Protective casing

Well Development:

Developed by Bailing. Very slow recovery and remained brown throughout development.

Comments:

WESTON

WESTON

DRILLING LOG

WELL NUMBER: L-1
OWNER:
LOCATION: Southeast side of lagoon
ADDRESS:
TOTAL DEPTH: 42'
SURFACE ELEVATION: 944.76
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/25/88
DRILLER: John Filbrun
HELPER: Ken Boehmer
LOG BY: L. Sherrerd Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5-7	1	SS	1-2 3-3	Slag gravel material, black-dark brown in a fine sand and silt matrix, some cinders, brick fragments (Fill), poorly sorted, dry.
10	10-12	2	SS	11-5 4-4	Top 3": Sandy and silty clay with some gravel, cinders, brick fragments, dark brown, poorly sorted, dry. Mid 3": Silt, orange brown with subangular gravel and trace fine sand. Bottom 4": Slag gravel, dark orange brown-brown in a medium-coarse sand matrix (Fill), very moist.
	15-17	3	SS	13-14 16-16	Fill material: Clayey and sandy silt, dark brown, poorly sorted, somewhat plastic with wood fragments. Grades into a medium clayey sand with iron staining and a large sandstone cobble in bottom.
20	20-22	4	SS	12-10 10-12	Top 7": Clayey silt with some medium sand, cobbles, dark brown to black. Cinders intermixed. - Fill. Bottom 10": Medium sand, well sorted, dark brown to light grey, moist.
	25-27	5	SS	80-85/5"	Plug material.
30	30-32	6	SS	12-9 30-21	Sandy silt, light brown with some small gravel intermixed, somewhat hard, dry.
	35-37	7	SS	135-32 34-31	White granular rock followed by sandy silt, hard, dry, dark brown with rounded cobbles, stratified, fine sand (red-brown) and hard sandstone.
40	40-42	8	SS	100/6'	Shale, grey to dark grey, platey, very broken up.

* A.S.T.M. D1586

SHEET 1 OF 1

DRILLING LOG

WELL NUMBER: L-2 | OWNER: American Home Prod.

LOCATION: | ADDRESS:

TOTAL DEPTH: 34.0'

SURFACE ELEVATION: | WATER LEVEL:

DRILLING COMPANY: Bowser-Morner | DRILLING METHOD: CableTool | DATE DRILLED: 5/17/88

DRILLER: Jim Nagurski | HELPER:

LOG BY: L. Lawlor

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0	1'-2'			-	Organic silty sand with gravel; gray-brown, moist
	2'-3'			-	Dark brown organic clay, wet
	3.5'-5'			13	Silty clay, dark brown with white and red specks, moist; some coarse sand, soft
5	5'-6'			-	Light brown clay, moist, high plasticity; little sand
	8'			-	Augers hitting gravel
10	8.5'-10.5'			13-7-9-11	Fill material, dark brown to light brown clay, black cinder material, steel scrap; moist
15	13'-15'			13-8-10-12	Same as above
	18'				Auger refusal
	18.5'			15-30-50	Fill material, dark brown-black, silty sand; wet
20	19.5'-20.5'			15-50-50	Top 3" light brown clay, wet with some fine sand; bottom 9" grey sand and silt with little gravel, dry

* A.S.T.M. D1586

DRILLING LOG

WELL NUMBER: L-2 OWNER: American Home Prod.
LOCATION: ADDRESS:
TOTAL DEPTH: 34.0'
SURFACE ELEVATION: WATER LEVEL:
DRILLING COMPANY: Bowser-Morner DRILLING METHOD: CableTool DATE DRILLED: 5/17/88
DRILLER: Jim Nagurski HELPER:

LOG BY: L. Lawlor

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20	21'-21.5'			50	Fill material, dark grey silty clay; wet
	22'			50-50	Fill material, grey silt, moist with some gravel
	23'-24.5'		40-2	7-34	Fine sand, moist from grey-light brown with streaks of reddish-brown
25	25'-27'	30-1	24-1	4-17	Fine sand, light brown, trace silt; moist
	27'-29'	18-1	14-1	4-18	Fine to medium sand, light brown, trace clay, some gravel subrouded up to ¼" diameter, cemented, stiff; moist
30	29'-31'	39-1	37-3	8-35	Silty sand, trace clay, stiff, moist, light brown, medium plasticity; little gravel
	31'-33'			15-50	Brown silt with 20% gravel up to 1/8" diameter, subrounded moist, high plasticity, very stiff
	33'-33.5'			50-50	No. Recovery
35	33.5'-34'			50	Gray, sandstone, dry
	34'-35'			50	Gray to white sandstone, dry, bed 33.0' BGS
40					

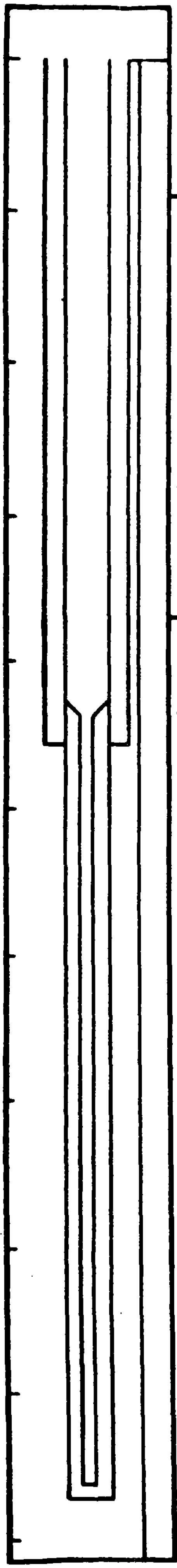
* A.S.T.M. D1586

SHEET 2 OF 2

Project American Home Products

Location Ekco, Massillon, OH

Personnel L. Lawlor



Well L-3

Well Construction Summary

Location or Coords: Northwest side of lagoon

Elevation: Ground Level 945.98

Top of Casing 946.78

Drilling Summary:

Total Depth 20'

Borehole Diameter 8" OD

Driller Bowser-Morner
John Filbrun

Rig Hollow Stem Auger

Bit(s)

Drilling Fluid Potable water

Surface Casing N/A

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"				
Geophys.Logging:				
Casing:/Screen: 4"	5/22	1600	5/22	1604
Filter Placement:	5/22	1605	5/22	1645
Cementing:	5/22	1715	5/22	1730
Development:	6/28	1500	6/29	1530
Other: SEAL:	5/22	1700	5/22	1705

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C = Casing S = Screen

C	-	9.5	+2
S	-	19.5	9.5

Casing: C1 4" Low carbon steel riser pipe

C2

Screen: S1 4" Stainless steel, Type 304, 10 feet.

S2

Centralizers N/A

Filter Material Sand, No. 2 to 8.0'

Cement Portland, Type I from 5.0' to surface

Other o Seal: Bentonite pellets
3' above top of casing
o Protective casing

Well Development:

Developed by Bailing. Bailed 18 gals. Water remained dark grey.

Comments:

WESTON
DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: L-3 OWNER:

LOCATION: Northwest side of lagoon Massillon, OH ADDRESS:

TOTAL DEPTH 20'

SURFACE ELEVATION: 945.98 WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: HSA DATE DRILLED: 5/22/88

DRILLER: John Filbrun HELPER: Ken Boehmer

LOG BY: L. Lawlor

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
		1	SS	3-3 4-5	3-5': Organic silty sand, dark black, moist grading into light brown silt, moist, high plasticity, moderately stiff, nonstratified.
5					
		2	SS	3-3 4-6	8-10': Sandy silt, light brown with 15% gravel up to 1½" diameter, subangular, soft, moist, low plasticity, lenses of black organic material and brown to red material
10					
		3	SS	50-90/5"	13-15': Top 6", sandy silt (as above). Lower 5", Silt, grey, dry, medium cementation, crumbles in fingers, nonstratified.
15					
		4	SS	60-51 44-43	18-20': Shale, dark grey, plately, weathered, dry - first encountered at 16.5'.
20					

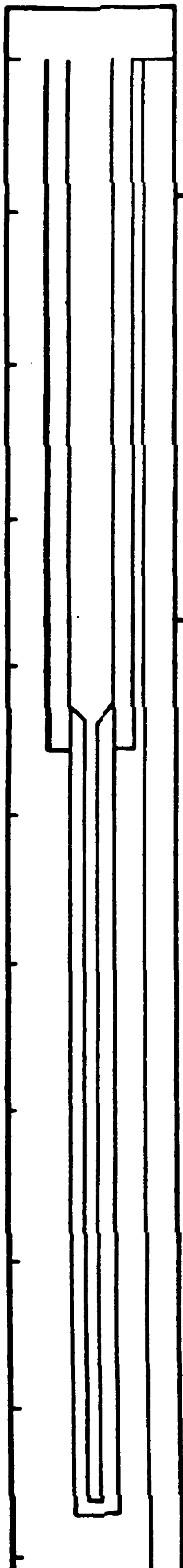
* A.S.T.M. D1586

SHEET 1 OF 1

Project American Home Products

Location Ekco, Massillon, OH

Personnel L. Lawlor



Well L-4

Well Construction Summary

Location or Coords: North side of lagoon near Newman Creek

Elevation: Ground Level 936.01

Top of Casing 938.11

Drilling Summary:

Total Depth 16'

Borehole Diameter 8"

Driller Bowser-Morner

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid N/A

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C	-	6	+2
S	-	16	6

Casing: C1 4" low carbon steel riser

C2 N/A

Screen: S1 4" Stainless steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Sand, No. 2 from bottom to 1 foot above top of screen

Cement Portland, Type I from 5 feet BGS to surface.

Other o Seal: Bentonite pellets from top of sand to 2.5 ft. BGS

o Protective casing

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	5/23	0945	5/23	1300
Geophys. Logging:				
Casing:/Screen 4"	5/23	1500	5/23	1505
Filter Placement:	5/23	1510	5/23	1530
Cementing:	5/23	1540	5/23	1700
Development:	6/28	1530	6/29	1600
Other: SEAL	5/23	1531	5/23	1533

Well Development:

Developed by Bailing. Slow recovery. Water cloudy at finish.

Comments:

WESTON

WESTON

DRILLING LOG

WELL NUMBER: L-4	OWNER:
LOCATION: North side of lagoon near Newman Creek	ADDRESS:
	TOTAL DEPTH: 16'
SURFACE ELEVATION: 936.01'	WATER LEVEL:
DRILLING COMPANY: Bowser-Morner	DRILLING METHOD: HSA
DATE DRILLED: 5/23/88	
DRILLER: John Filbrun	HELPER: Ken Boehmer
LOG BY: L. Laylor	

SKETCH MAP

NOTES:

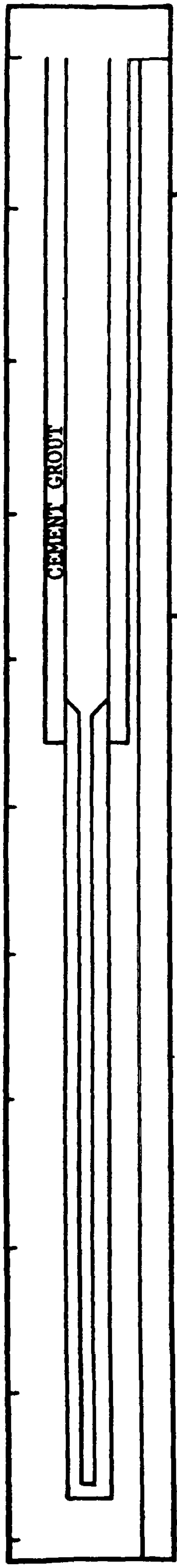
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
		1	SS	16-12 7-5	3-5': Sandy silt, light brown, dry, some organic material, medium cementation. Bottom 2": Grey silt, moist with gravel up to 1½" diameter, subrounded.
5					
					Water first encountered at 7.0'.
		2	SS	10-8	8-10': Silt and gravel, some sand. Grey silt with 30% gravel up to 1½" diameter, subrounded, saturated, some medium sand (20%), stiff, nonstratified.
10					
		3	SS	32-40 60/3"	As above.
		4	SS	10-44 45-57	14-16': Sand and gravel, fine grey sand, well graded, saturated, weak cementation, with 20% large (1"-2" diameter) gravel.
15					
20					

* A.S.T.M. D1586

Project American Home Products

Location Ekco, Massillon, OH

Personnel L. Lawlor



Well L-5

Well Construction Summary

Location or Coords: Northeast side of lagoon by Newman Creek

Elevation: Ground Level 934.54

Top of Casing 936.86

Drilling Summary:

Total Depth 27'

Borehole Diameter 8"

Driller Bowser-Morner
John Filbrun

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid N/A

Surface Casing N/A

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	5/24	0915	5/24	1328
Geophys. Logging:				
Casing:/Screen 4"	5/24	1405	5/24	1407
Filter Placement:	5/24	1400	5/24	1520
Cementing:	5/24	1535	5/24	1555
Development:	6/28	1545	6/29	1015
Other: SEAL	5/24	1530	5/24	1531

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C	-	14	+2
S	-	24	14

Casing: C1 4" Low carbon steel riser

C2 N/A

Screen: S1 4" Stainless steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Sand, No. 2 from bottom to 1 foot above top of screen.

Cement Portland, Type 1 from 8 ft. BGS to surface.

Other o Seal: Bentonite pellets from top of sand to 8 feet BGS.
o Protective casing

Well Development:

Developed by bailing and pumping. Pumped a total of 75 gals. @ ½gpm.

Comments:

WESTON

DRILLING LOG

WELL NUMBER: L-5 OWNER: American Home Prod

LOCATION: ADDRESS:

TOTAL DEPTH 29'

SURFACE ELEVATION: WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: CableTool DATE DRILLED: 6/30/88

DRILLER: Jim Nagurski HELPER:

LOG BY: L.S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER / SAMPLE TYPE / SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
5'-7'		1-2-4-9	No Recovery
7'-9'		9-10-26-17	Sandy silt and gravel, 30% grain up to 1" diameter, subrounded, grey silt, saturated, weak cementation, non-stratified
9'-11'		14-11-14-20	Silt and gravel, trace sand, grey silt with 30% grain up to 1" diameter, subrounded, low plasticity, some sand, wet
11'-13'		9-17-20-18	Sand and gravel up to 1" diameter, grey fine-medium sand, saturated, weak cement, non-stratified
13'-15'		25-18-18-21	Sand fine-medium, saturated, grey, weak cement, well graded
15'-17'		13-17-19-15	Top 10" sand same as above; bottom 2" sand same as above with some silt
17'-19'		9-16-16-16	Upper 6" silt and gravel up to 1" diameter, gray; lower sand fine-medium saturated, well graded, weak cement, grey
19'-21'		8-10-7-10	Sand same as above

Depth scale: 0, 5, 10, 15, 20

* A.S.T.M. D1586

SHEET 1 OF 2

WESTON

DRILLING LOG

WELL NUMBER: L-5
OWNER: American Home Prod.
LOCATION:
ADDRESS:
TOTAL DEPTH 29'
SURFACE ELEVATION:
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: CableTool
DATE DRILLED: 6/30/88
DRILLER: Jim Nagurski
HELPER:
LOG BY: L.S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20	21'-23'	5	18-22	-17	Upper 3" sand as above; lower silt and gravel, 30% gravel up to 1" diameter, subrounded, low plasticity, non-stratified, saturated, trace sand
	23'-25	7	11-16	-21	Silt with gravel trace sand, grey stiff, low plasticity, non-stratified
25	25'-27'	11	14-15	-30	Silt with gravel, trace sand same as above
	27'-29'	10	26-25	-21	Silt and gravel, same as above
30					

* A.S.T.M. D1586

SHEET 2 OF 2

Project American Home Products

Location EKCO Massillon, OH

Personnel L. Sherrerd Steele

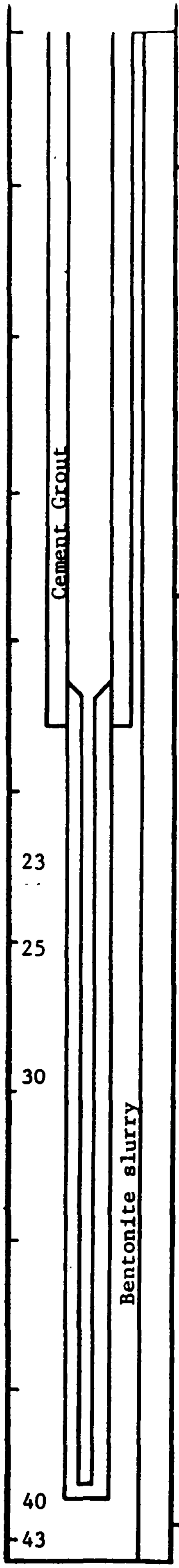
Well Construction Summary

Well P-3

Location or Coords: 3rd St. NW next to Ohio Water Service

Elevation: Ground Level 930.84

Top of Casing 933.60



Drilling Summary:

Total Depth 43'

Borehole Diameter 4½"

Driller Bowser-Morner
Joe Filbeum

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid Potable water

Surface Casing

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C=Casing S=Screen

C	30	+2
S	40	30

Casing: C1 2" PVC, schedule 40

C2 N/A

Screen: S1 2" PVC, 10 slot, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from 43' BGS to 25' BGS

Cement Portland, Type I, from 23' BGS to surface

Other Seal: Bentonite slurry from tip of sand to 23' BGS
- Protective casing

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 8"	6/1/88	0745	6/2/88	0710
Geophys. Logging:				
Casing: /Screen 2"	6/2/88	1015	6/2/88	1020
Filter Placement:				
Cementing:	6/2/88	1200	6/2/88	1610
Development:				
Other: Seal	6/2/88	1150	6/2/88	1200

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: P-3
LOCATION: 3rd St. NW
Massillon OH

SURFACE ELEVATION: 930.84

DRILLING COMPANY: Bowser-Morner

DRILLER: Joe Falbo

LOG BY: L. S. Steele

OWNER:
ADDRESS:

TOTAL DEPTH 40'
WATER LEVEL:

DRILLING METHOD: HSA

DATE DRILLED: 6/1/88

HELPER: Lee Bechtol

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	3.5' 5.5'	1	SS	6-6 6-7	Clay, medium brown to orange-brown with fine to medium sand and trace silt; increasing sand content with depth; sand lenses throughout (¼" thick); moist
5					
	8.5' 10.5'	2	ss	26-20 25-30	Clay, dark brown, loose, intermixed with medium sand, light brown and angular gravel (2" diameter); wet First Encountered Water @ 9.0'
10					
	13.5' 15.5'	3	SS	9-9 9-15	Fine sand, dark brown with clay grading into fine to medium sand, dark grey intermixed with rounded to subrounded pebbles and gravel (50%); wet
15					
	18.5' 20.5'	4	SS	27-17 17-9	Gravel ½"-2" diameter, subangular to subrounded in a fine sand matrix, brown to grey, loose, poorly sorted, wet
20					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: P-3
LOCATION: 3rd St NW
Massillon OH

OWNER:
ADDRESS:

TOTAL DEPTH: 40'
SURFACE ELEVATION: 930.84
WATER LEVEL:

DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 6/1/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L.S. Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20					
	23'-25'	5	SS	27-23 11-17	Medium sand, medium grey, well sorted, grading into coarse sand with gravel (½" diameter) and large cobbles (2" diameter) wet, poorly sorted
25					
	28'-30'	6	SS	9-11 10-12	Medium sand, grey to dark grey, well sorted, few fines grading into coarse sand with cobbles (½" diameter); wet
30					
	33'-35'	7	SS	4-5 7-7	Medium to coarse sand matrix, dark grey, with gravel and cobbles (½"-1" diameter) and a ¼" thick clay lense; wet
35					
	35'-40'	8	SS	27-17 10-10	Medium sand, grey, well sorted, grading into gravel and cobbles in a medium sand matrix; wet
40					

* A.S.T.M. D1586

Well P-4

Well Construction Summary

Location or Coords: 250' North of Newman Creek between Rail Tracks

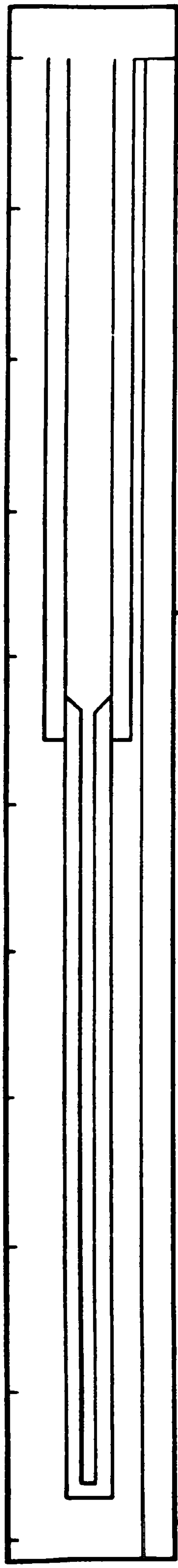
Elevation: Ground Level 936.60

Top of Casing 938.48

Project American Home Products

Location EKCO, Massillon, OH

Personnel L. Sherrerd Steele



Drilling Summary:

Total Depth 108'

Borehole Diameter 4¼"

Driller Bowser-Morner
Joe Falbo

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid Potable water

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C	98	+2
S	108	98

Casing: C1 2" Low carbon steel with L.C. couplings

C2 N/A

Screen: S1 2" Stainless steel, type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from bottom to 92.5' BGS

Cement Portland, Type I from top of seal to surface.

Other o Seal: Bentonite slurry from top of sand to 88' BGS
o Protective casing

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 4¼"	5/18	1030	5/25	1715
Geophys. Logging:				
Casing/Screen: 2"	5/26	0950	5/26	1005
Filter Placement:				
Cementing:	5/26	1330	5/26	1630
Development:	6/28	0930	6/28	1120
Other: Seal	5/26	1300	5/26	1315

Well Development:

Water was very cloudy and silty at first. At finish it was slightly cloudy. Developed by air lifting. Pumped at a rate of 2-3 gpm.

Comments:

WESTON

WESTON

DRILLING LOG

WELL NUMBER: P-4
OWNER:
LOCATION: 250' North of Newman Creek between Rail tracks, Massillon, OH
ADDRESS:
TOTAL DEPTH 108'
SURFACE ELEVATION: 936.60
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/18/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L. Lawlor

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0	3-5	1	SS	5-3 3-3	Silty clay, organic, black, nonstratified, weak cementation, with 30% gravel, moist.
10	8-10	2	SS	5-7 8-10	Clay, mottled with light grey, orange brown and black discontinuous clay lenses, nonstratified, stiff, moist.
	13-15	3	SS	13-43 45-47	Silty sand and gravel (subrounded up to 1½" diameter, 40%) grades from dark grey to light brown, weak cementation, possibly fill material, poorly graded, nonstratified, wet.
20	18-20	4	SS	36-27 22-21	Sand and gravel, 60% gravel up to 1½" diameter, subrounded, medium sand, some silt brown-orange brown, poorly graded, nonstratified, weak cement, saturated.
	23-25	5	SS	43-27 17-15	No recovery.
30	28-30	6	SS	21-20 18-19	fine-medium sand, well graded, nonstratified, saturated, brown, weak cement, some silt.
	33-35	7	SS	24-22 17-18	Silty sand and gravel, 30% gravel, up to 1½" diameter, subrounded, silty sand is grey-brown, saturated, (6" silt with gravel up to 1/8" diameter, moist, stiff grey), poorly graded, nonstratified.
40	38-40	8	SS	28-22 20-18	No recovery.

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: P-4
LOCATION: 250' North of Newman Creek between rail tracks, Massillon, OH
SURFACE ELEVATION: 936.60'
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/18/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L. Lawlor
OWNER:
ADDRESS:
TOTAL DEPTH: 108'
WATER LEVEL:

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40					
	43-45	9	SS	15-12 15-29	Silty sand and gravel, 50% gravel up to 1" diameter, subrounded, grey-brown, silty sand, poorly graded, weak cement, saturated.
	48-50	10	SS	31-21 29-30	Silt with gravel, 30% gravel up to 1" diameter, subrounded-subangular, grey silt, moist stiff, nonstratified, poorly graded.
50					
	53-55	11	SS	15-47 37-37	As above.
	58-60	12	SS	21-22 50/5"	Silt, with 20% gravel up to 3/4" diameter, subrounded-subangular, grey, wet, stiff.
60					
	63-65	13	SS	50-36 25-25	Silty sand and 40% gravel up to 1½" diameter, subrounded, subangular, poorly graded, weak cement, grey, wet, nonstratified.
	68-70	14	SS	28-26 32-38	Silt with 10% gravel up to ½" diameter, grey, moist, stiff, nonstratified.
70					
	73-75	15	SS	40-30 40-50/3"	Silt with 30% gravel up to ½" diameter, subrounded to subangular, grey silt, moist, stiff nonstratified, high plasticity.
	78-80	16	SS	20-18 17-22	Sand and gravel, up to 1½" diameter, subangular, medium-coarse sand, weak cement, nonstratified, saturated, gray, trace silt.
80					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: P-4
OWNER:
LOCATION: 250' North of Newman Creek between rail tracks, Massillon, OH
ADDRESS:
TOTAL DEPTH: 108'
SURFACE ELEVATION: 936.60'
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/18/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L. Lawlor

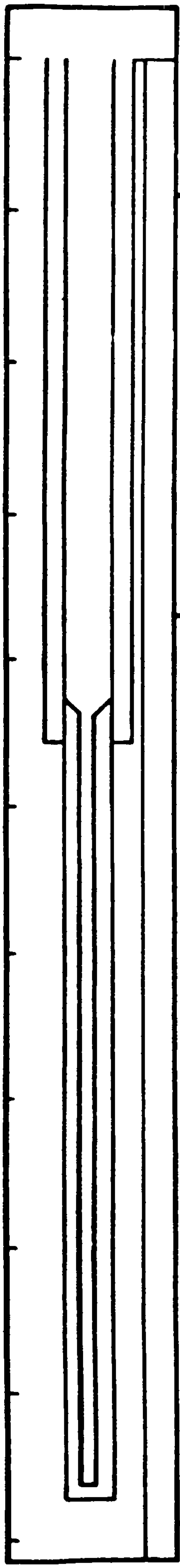
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
80					
	83-85	17	SS	30-27 32-29	Sand and gravel up to 3/4" diameter, subangular, coarse sand, saturated, weak cement, nonstratified, grey, some silt.
	88-90	18	SS	22-28 37-50	Silt with 30% gravel up to 1" diameter, subangular, grey silt, saturated, stiff, poorly graded.
90					
	93-95	19	SS	100/ 5"	No recovery.
	98-100	20	SS	75- 100/3"	Silt and 40% gravel up to 3" diameter, subrounded, grey, saturated, stiff, nonstratified in top 5" of spoon. 5"-12": Sand and gravel up to 3" diameter, coarse sand, trace silt, weak cement, nonstratified, grey.
100					
	103-105	21	SS	100- 100/5"	Sand and 60% gravel up to 3" diameter, subrounded, fine-coarse sand, grey, saturated, weak cement, poorly graded, nonstratified, trace silt.
	108'	22	SS	150/ 3"	Bedrock.
110					

* A.S.T.M. D1586

Location Ekco, Massillon, OH
Personnel L. Sherrerd Steele
Project American Home Products



Well P-5

Well Construction Summary

Location or Coords: 5 feet west of D-1-27

Elevation: Ground Level 946.11

Top of Casing 948.34

Drilling Summary:

Total Depth 33'

Borehole Diameter 8" OD

Driller Bowser-Morner
Joe Falbo

Rig Hollow Stem Auger

Bit(s)

Drilling Fluid Potable water

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ____

Casing String(s): C = Casing S = Screen

C	27	+2
S	33	27

Casing: C1 2" ID PVC pipe

C2 N/A

Screen: S1 5' of 2" PVC screen, 10-slot.

S2

Centralizers N/A

Filter Material Sand, No. 2, 2 feet above top of screen.

Cement Type 1 Portland cement from 23' - 0'.

Other o Seal: Bentonite pellets 2 ft. above sand pack.
o Protective casing

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	5/17	0909	5/17	1621
Geophys. Logging:				
Casing:/Screen 2"	6/3	0715	6/3	0730
Filter Placement:	6/3	0735	6/3	0810
Cementing:	6/3	0830	6/3	0930
Development:	6/28	1400	6/3	1030
Other: Bentonite Seal	6/3	0812	6/3	0817

Well Development:

Developed by Air Lifting. Total of 35 gals. pumped. Went dry after several minutes of pumping.

Comments:

WESTON

WESTON

DRILLING LOG

WELL NUMBER: P-5
OWNER:
LOCATION: ≈ 5 feet west of D-1-27 Massillon, OH
ADDRESS:
SURFACE ELEVATION: 946.11
TOTAL DEPTH: 33'
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/17/88
DRILLER: Joe Falbo
HELPER: Lee Bechtel
LOG BY: L. Lawlor

SKETCH MAP

NOTES: HNu background = 1.0ppm

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0	1-2	1	SS	-	Organic silty sand with gravel, grey-brown, moist. HNu = 4-5ppm.
	2-3		SS	-	Organic clay, dark brown, wet.
	3.5-5	2	SS	-	Silty clay, dark brown with white and red specks, some coarse sand, soft, moist.
	5-6	3	SS	-	Clay, light brown, high plasticity, little sand, moist.
5					
	8.5-10	4	SS	-	Fill material, clay, dark brown-light brown, black cinders, steel scrap, moist.
10					
	13-15	5	SS	13-8 10-12	Fill material, clay, dark brown-light brown, brick fragments, metal fragments, moist.
15					
	18.5	6	SS	15-30 50/5"	Fill material, dark brown-black silty sand, wet.
	19.5 20.5	7	SS	15-50 50/4"	3" light brown clay, wet with some fine sand, followed by 9" grey sand, silt with little gravel, dry (probably fill).
20					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: P-5
OWNER:
LOCATION: ≈ 5 feet west of D-1-27 Massillon, OH
ADDRESS:
TOTAL DEPTH: 33'
SURFACE ELEVATION: 946.11
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/17/88
DRILLER: Joe Falbo
HELPER: Lee Bechtel
LOG BY: L. Lawlor

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20	21-21.5	8	SS	50/4"	Fill material, dark grey silty clay, wet.
	22	9	SS	50-50/3"	Fill material, silt, grey, some gravel, moist.
	23-24.5	10	SS	40-27 34-40	Fine sand, grey to light brown with streaks of reddish brown to dark brown, moist.
25	25-27	11	SS	30-24 14-17	Fine sand, light brown, trace silt, moist.
	27-29	12	SS	18-14 14-18	Fine-medium sand, light brown, trace clay (1/8" layers), some gravel, subrounded, up to ¼" diameter, cemented, stiff, moist.
	29-31	13	SS	39-37 38-35	Silty sand, trace clay, stiff, moist, light brown, medium plasticity, little gravel.
30	31-33	14	SS	15-50 50/2"	Silt, brown with 20% gravel, up to 1/8" diameter, subrounded, very stiff, moist, high plasticity.
	33-35	16	SS	50/3"	Sandstone, grey, dry.
35					

* A.S.T.M. D1586

SHEET 2 OF 2

Well Construction Summary

Well R-5

Location or Coords: 10' south of L-5

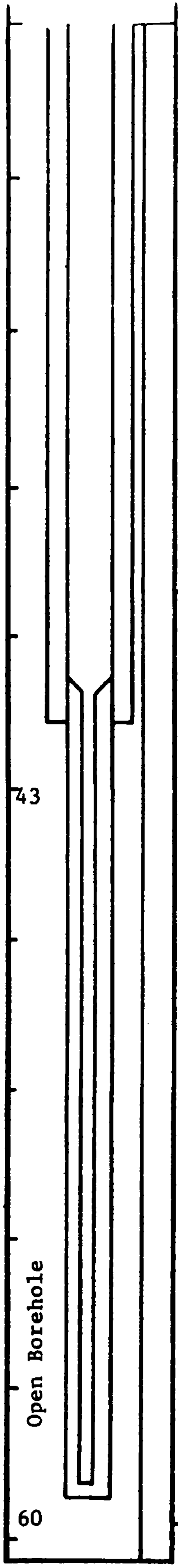
Elevation: Ground Level

Top of Casing

Location EKCO Massillon OH

Personnel L. Sherrerd Steele

Project American Home Products



Drilling Summary:

Total Depth 60'

Borehole Diameter 6"

Driller Bowser-Morner
Jeff Riddle

Rig Cable Tool

Bit(s) 5 7/8"

Drilling Fluid Potable H2O

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C = Casing S = Screen

C - 43 +2

Casing: C1 6" Low Carbon Steel
43'

C2 N/A

Screen: S1 N/A

S2 N/A

Centralizers N/A

Filter Material N/A

Cement N/A

Other N/A

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 5 7/8"	7/22/88	1550	7/23/88	1230
Geophys. Logging:				
Casing: 6"	7/22	1445	7/23	0830
Filter Placement:				
Cementing:				
Development:	7/23	1500	7/23	1530
Other:				

Well Development:

Developed well for ½ hour at 10 gpm. Water was clear.

Comments:

Bedrock encountered at 41 ft below ground surface

See geologic log of well L-5

WESTON
DESIGNERS CONSULTANTS

Project American Home Products
Location EKCO Massillon OH
Personnel L. Sherrerd Steele

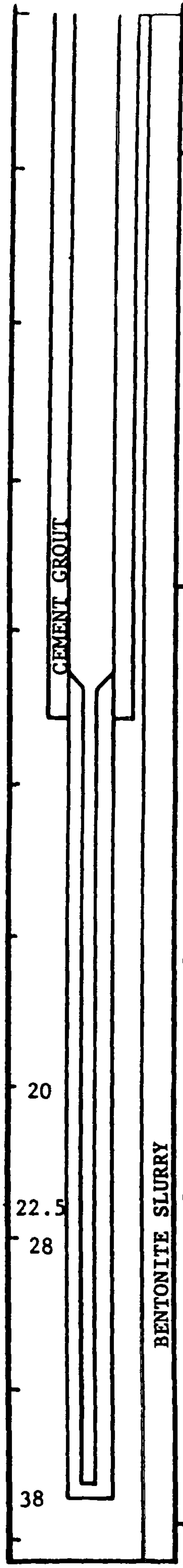
Well Consti uction Summary

WELL S-7

Location or Coords: 20' ease of RR and 600' North of State St. next to I-7

Elevation: Ground Level ______

Top of Casing ______



Drilling Summary:

Total Depth 38'

Borehole Diameter 8"

Driller Bowser-Morner
Jeff Riddle

Rig Cable Tool

Bit(s) 7 5/8"

Drilling Fluid Potable H20

Surface Casing N/A

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: 7 5/8"	7/19 /88	1345	7/19 /88	1700
Geophys. Logging:				
Casing:/Screen 4"	7/19	1704	7/19	1714
Filter Placement:				
Cementing:	7/19	1830	2/19	1930
Development:	7/23	1000	7/23	1100
Other: Seal	7/19 /88	1800	7/19 /88	1820

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

C	28	+2
S	38	28

Casing: C1 4" Low Carbon Steel

C2 N/A

Screen: S1 4" Stainless Steel, Type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural Sand Pack from bottom to 22 ½' BGS

Cement Portland, Type I from top of seal to surface

Other Seal: Bentonite slurry from top of sand to 20' BGS
- Protective casing

Well Development:

Purged well for 1 hour at 13.5 gpm. Water was very clear.

Comments:

See geologic log for well I-7

WESTON DESIGNERS CONSULTANTS

APPENDIX E

PUMPING TEST METHODOLOGY

WESTON
MANAGERS DESIGNERS CONSULTANTS

PUMPING TEST METHODOLOGY

The specific protocol for the pumping tests is as follows:

1. Open well caps and monitor downhole and ambient air quality using monitoring equipment. Record information in field notebook.

2. Measure and record depth to water from the top of the casing in all observation wells to be tested and also in the pumping well. Record as static pumping level (pretest level) in the field notebook.

3. Protect the transducer cables by taping the casing of the observation wells and pumping well with duct tape to cover the top edge.

4. Clean each transducer by sequentially rinsing the probe and attached line with tap water, Alconox in tap water, and distilled water.

5. Lower the transducers into the observation wells and pumping well to a depth of approximately 10 ft below the top of the static pumping level, calibrate them according to manufacturer's directions, and secure the transducer cable with duct tape.

6. Connect the data loggers (SE-2000 or equivalent) to the transducers. The data loggers serve to automatically record water level fluctuations in each of the monitor wells with time.

7. Activate the data loggers at least 12 hours before the start of the pumping test to establish background water level conditions. Record the water levels approximately every 30 minutes.

8. Initiate pumping; collect water-level measurements at the pumping well and observation wells at the following preselected time intervals:

Time Since Pumping Started (or Stopped) in Minutes	Time Interval Between Measurements in Minutes
0-10	0.01-0.5
10-15	1
15-60	5
60-termination of test	30

9. Closely monitor the pumping rate throughout the test. Adjustments will be made to the pump, as necessary, in order to maintain a constant pumping rate.

10. Continue constant rate pumping for approximately 8 hours.

11. Collect water level recovery data following the same preselected measurement intervals as during the pumping period. Drawdown will be monitored for a period of 4 hours, or until water levels have returned to near pretest levels, whichever comes first.

12. After the test, but before the data loggers are stopped, generate a hard copy of the data readings on the field printer.

13. Remove the transducers and the pump from the wells and decontaminate.

14. Replace and lock the well caps.

MANAGERS DESIGNERS CONSULTANTS

APPENDIX F

SOIL BORING COMPLETION AND SAMPLING METHODOLOGY

WESTON
MANAGERS DESIGNERS CONSULTANTS

SOIL BORING COMPLETION AND SAMPLING METHODOLOGY

Soil borings will be advanced in areas of suspected contamination in order to assess the quantity and vertical distribution of the VOCs present in the soil.

At each location, samples will be collected from depths of 0 to 2 ft, 4 to 6 ft, and 10 to 12 ft below ground surface or at the discretion of the on-site geologist based upon vapor detection, discoloration, or other field indicators. The samples will be analyzed for VOCs.

The specific soil sampling protocol is as follows:

1. Boring locations will be staked and then approved by representatives of EKCO.
2. Boreholes will be drilled using a hollow-steam auger drilling rig.
3. Soil samples will be continuously collected from the boreholes. These subsurface samples will be obtained with a 2-ft-long split-spoon sampler driven in advance of the bottom of the auger hole, according to the ASTM (D-1586) Standard Penetration Test, to the top of the water table.
4. A detailed drilling log and record of all samples will be maintained by the field geologist/soil scientist. Each split-spoon barrel will be decontaminated between samples according to specifications discussed in this section. Extraneous sample material and drilling cutting will be containerized and disposed of properly.
5. The boring holes will be backfilled immediately after sampling.
6. One discrete sample will be collected for chemical analysis from each interval of 0 to 2 ft, 4 to 6 ft, and 10 to 12 ft, or from the intervals that the field geologist/soil scientist deems most likely to have contamination.
7. One sample for every 20 collected for analysis will have a duplicate for quality control.

The actual steps to be followed while collecting the samples are as follows:

1. Record split-spoon depth, blow count, and driller's comments in field logs.

2. If samples for chemical analysis are required, as outlined above, the sampler will immediately transfer selected samples into prepared appropriate size jars. The outside portion of the sample will be scrapped away and discarded. An aliquot should be left in the spoon for later description.

3. Examine and record in the field logbook the descriptions of the split-spoon sample, including sample recovery, color, grain size, distribution, plasticity, and moisture content. Organic vapor detector readings will also be recorded. These data will be transferred to a boring log form.

4. Close and label sample bottles and record all information in field notebooks.

5. Decontaminate the split spoon.

6. Prepare samples for shipping as environmental samples.

APPENDIX G

GROUNDWATER SAMPLING METHODOLOGY

GROUNDWATER SAMPLING METHODOLOGY

The objective of this task is to obtain representative groundwater samples. Wells suspected of having low contaminant concentrations will be sampled prior to those suspected of having medium or high contaminant concentrations. The field measurements of the water levels in the wells will be used to prepare separate potentiometric maps for the bedrock and unconsolidated deposits.

Monitor Well Sampling

The procedure for sampling monitor wells is as follows:

1. Scan the area around the well with HNu/OVA. Record external air measurements in logbook.

2. Open well cap and monitor downhole and ambient air quality using monitoring equipment.

3. Record the following well information and measurements on well sampling forms:

   a. Well identification and location (at the time of each sampling).

   b. Well integrity.

   c. Height of casing above ground surface (in feet).

   d. Downhole and ambient air readings detected with HNu/OVA (at the time of each sampling).

   e. Depth of water level (feet) from the top of casing (at the time of each sampling).

      Water level measurements will be taken to the nearest 0.01-ft with respect to mean sea level on top of the well casing. All measuring devices used in the well will be washed with laboratory-grade detergent solution and thoroughly rinsed with distilled water prior to reuse. The depth of the top of the water will be subtracted from the total casing depth to determine the height and, subsequently, the volume of standing water in the casing.

f. Total depth of well and depth to top of sediment layer, if present (in feet).

g. Total volume of standing water in the well.

4. Take a sample for dense, nonaqueous-phase liquids in the bottom of all on-site wells to be sampled using a BAT Envitech Hydroprobe sampler. If the visual inspection and/or head space analysis of the vial indicates the presence of a dense, nonaqueous-phase liquid, then the groundwater will not be sampled in this well(s). The BAT sample vial will then be sent to the laboratory for volatile organic analysis. The hydroprobe will be decontaminated between samples by steam-cleaning the outside of the sampling unit and activation tubing. The hypodermic needle and sampling vial will be replaced between wells.

5. Evacuate a minimum of three well volumes of water from shallow and deep wells using a submersible or suction pump. If the well recharges fast enough during purging so that the water level is not drawn down or drawdown is slow, place the pump intake near the top of the water level and lower as needed. This will ensure that the water near the top of the casing that will be sampled by the bailer is replaced. Record the volume of water removed and the elapsed time of purging. The purge water will be discharged into a tanker and taken to the air stripper for processing.

6. Allow well to recharge. Record time required for recharge.

7. Use a dedicated, precleaned, stainless steel or teflon bottom-filling bailer with stainless steel leaders to obtain the sample. Attach a braided polyethylene cord to the bailer and slowly lower the bailer into the well. After the bailer has filled, slowly raise the bailer from the well. Do not allow the bailer to touch the ground. Fill the volatile organic analysis bottle first, checking to confirm that the vial is free of all air bubbles. The sample for dissolved metals will be filtered through a 0.45-micron filter prior to preservation. Fill the remaining sample containers by splitting each bail full of water among the various sample jars. Add preservatives to the sample containers, as appropriate. Appropriately discard the cord after each use.

8. Seal and label the sample bottles. Record all pertinent information on each sample (color, odor, sheen, etc.) in the field sampling notebook.

9. Record the field parameters (pH, electric conductivity, and temperature) at each sample collection point.

10. Replace well cap. Make sure well is readily identifiable as to the source of the sample. Well sample analysis parameters, sample volumes, and container types are given in this section.

11. Pack samples for shipping. Add ice and vermiculite and seal the cooler for shipment.

12. All sampling equipment will be decontaminated after sampling as detailed in this section to prevent cross-contamination.

Facility Production Well Sampling

Groundwater sampling of the facility production wells will be accomplished using the existing permanent pumps. The static pumping rate will be measured. Wells that are on-line at the time of sampling will be purged by allowing water to flow through the sampling valve for 1 minute. Wells not on-line but serviceable at the time of sampling will be restarted by a EKCO representative and allowed to run for approximately 15 minutes prior to opening the sampling valve. After the wells have been purged, each sample container will be gently filled from the pump line taking care to avoid aeration and turbulence in the sample. A clean glass rod may be used, if necessary, to conduct the flow into the sample container.

WESTON
MANAGERS DESIGNERS CONSULTANTS

APPENDIX H

GEOPHYSICAL LOGS OF WELLS R-1, R-2, AND R-4

WESTON

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.91 Feet above MSL	

COMPANY: R.F WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION: R-1

STATE: OHIO
COUNTY: STARK

COORDINATES:
N:
E:
ELEVATION: KB:
DF:
GL:

EDI JOB NO: 901
WELL: R-1
LOCATION: MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	167'	Fluid Viscosity	
Footage Logged	167'	Fl. Resistivity	
Bottom (Driller)	170'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)	42'	Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
CALIPER TEMPERATURE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.91 Feet above MSL	

COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION: R-1

STATE: OHIO
COUNTY: STARK

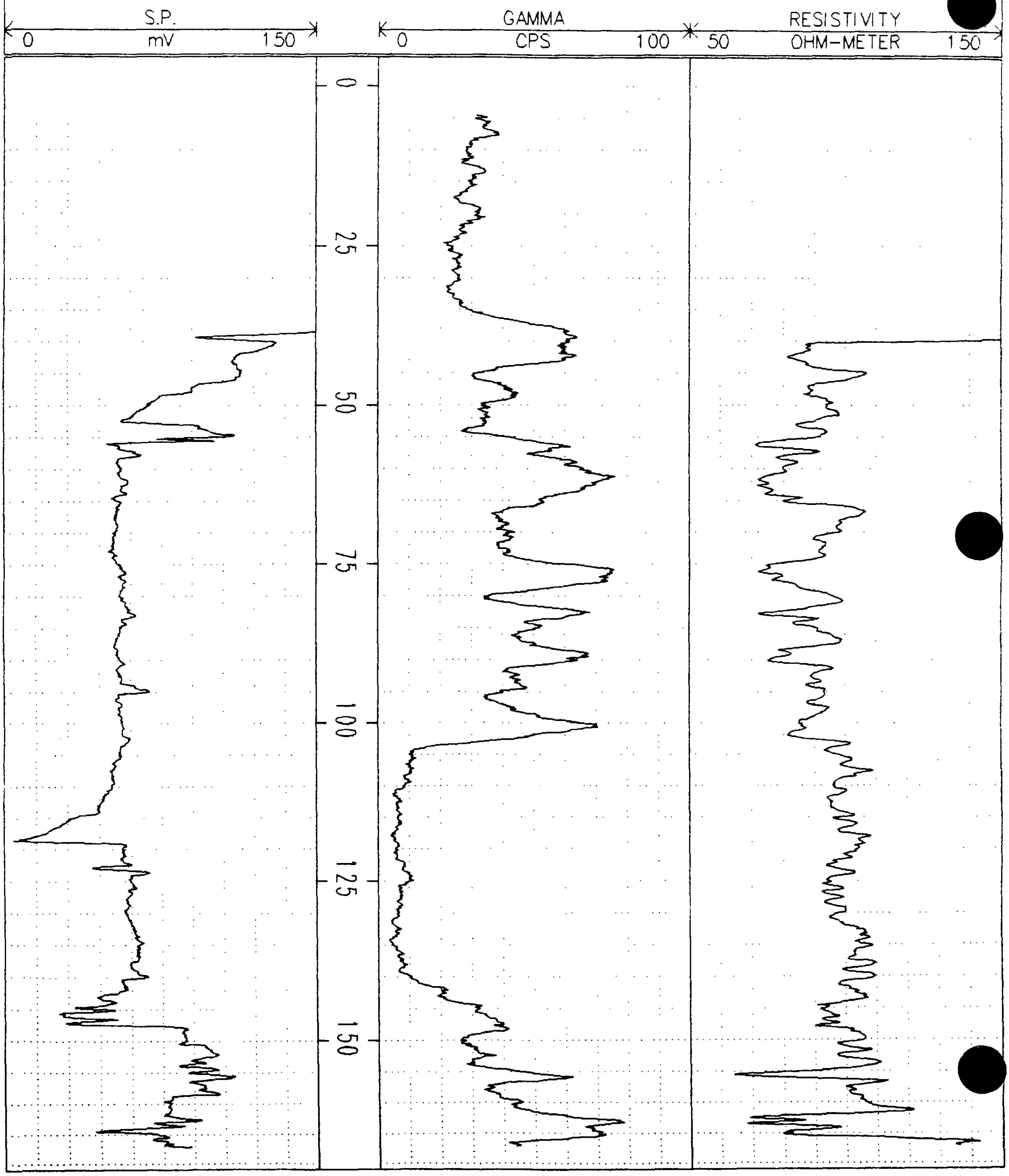
COORDINATES:
N:
E:
ELEVATION: KB:
DF:
GL:

EDI JOB NO: 901
WELL: R-1
LOCATION: MASSILLON, OHIO

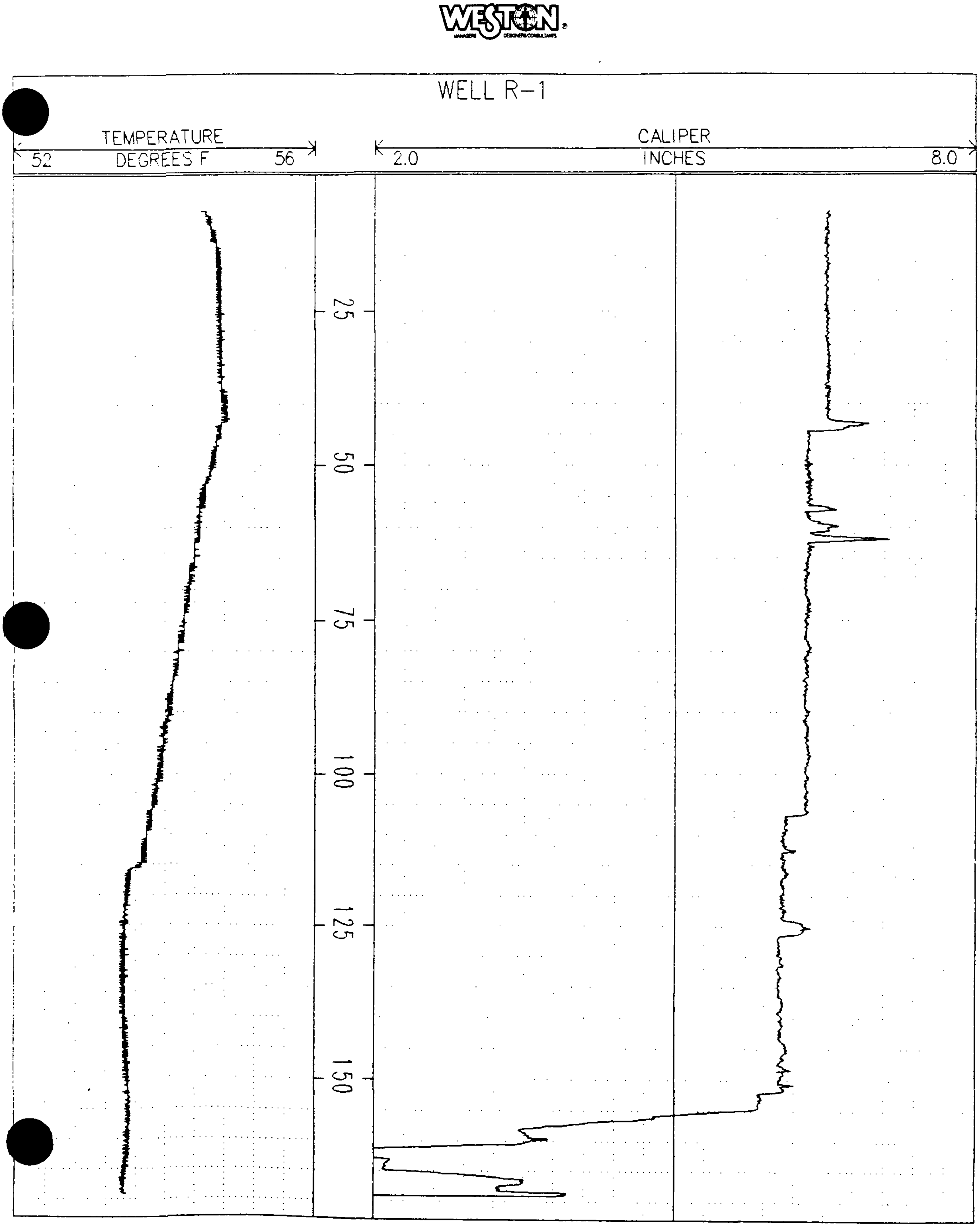
	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	169'	Fluid Viscosity	
Footage Logged	169'	Fl. Resistivity	
Bottom (Driller)	170'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)	42'	Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

WELL R-1



S.P.
0 mV 150
GAMMA
0 CPS 100
RESISTIVITY
50 OHM-METER 150
0
25
50
75
100
125
150


WESTON
WELL R-1
TEMPERATURE
DEGREES F
52
56
CALIPER
INCHES
2.0
8.0
25
50
75
100
125
150

WESTON

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG: SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	PERMANENT DATUM: Mean Sea Level LOG MEASURED FROM. TOP OF CASING ELEVATION 946.32 Feet above MSL	OTHER SERVICES

COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION: R-2

STATE: OHIO
COUNTY: STARK

COORDINATES:
N:
E.
ELEVATION: KB:
DF:
GL:

EDI JOB NO: 901
WELL: R-2
LOCATION: MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	153'	Fluid Viscosity	
Footage Logged	153'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY	MICHAEL LEDWITH
		WITNESSED BY.	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG: CALIPER TEMPERATURE	PERMANENT DATUM: - Mean Sea Level LOG MEASURED FROM: TOP OF CASING ELEVATION 946.32Feet above MSL	OTHER SERVICES.

COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION. R-2

STATE: OHIO
COUNTY: STARK

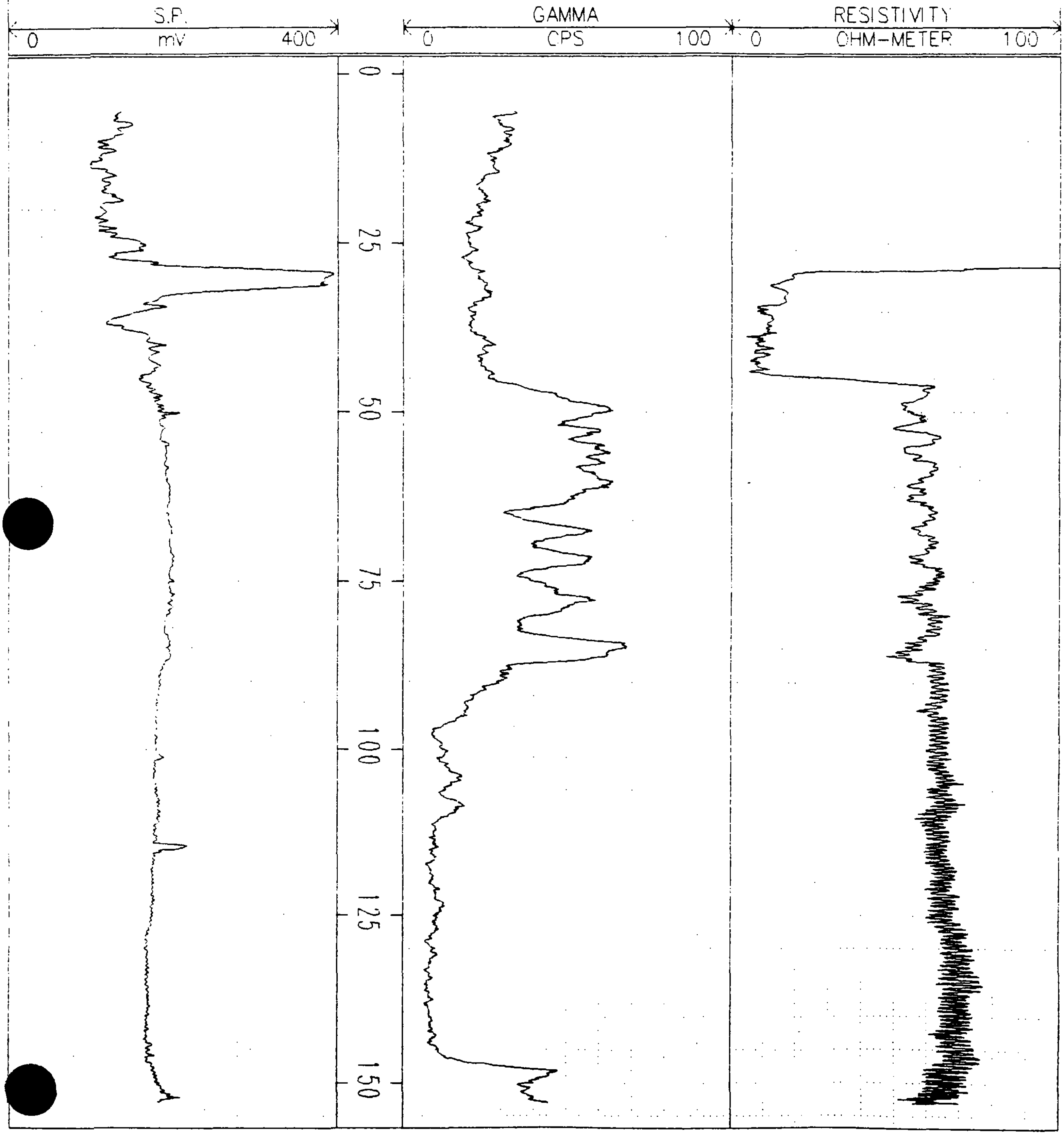
COORDINATES.
N:
E.
ELEVATION: KB
DF.
GL

EDI JOB NO: 901
WELL R-2
LOCATION. MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int	0'	Fluid Nature	WATER
Top Logged Int.	140'	Fluid Viscosity	
Footage Logged	140'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY.	PAUL LANDRY

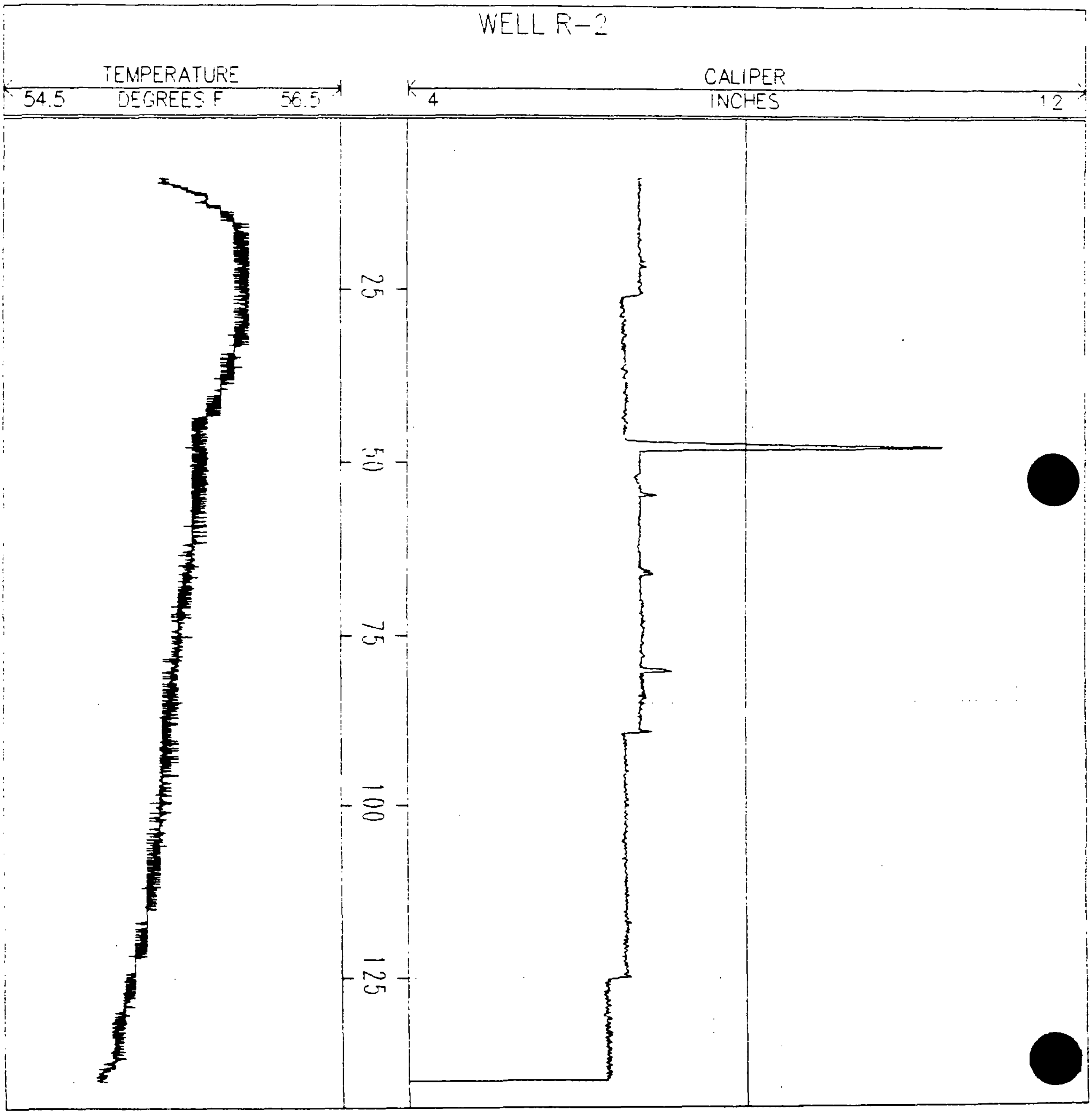
REMARKS: ZERO AT TOP OF CASING

WELL R-2



S.P.
0 mV 400
GAMMA
0 CPS 100
RESISTIVITY
0 OHM-METER 100
0
25
50
75
100
125
150

WESTON



WELL R-2
TEMPERATURE
54.5
DEGREES F
56.5
CALIPER
4
INCHES
12
25
50
75
100
125

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG. SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	PERMANENT DATUM: Mean Sea Level LOG MEASURED FROM: TOP OF CASING ELEVATION 933.28 Feet above MSL	OTHER SERVICES:

COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION. R-4

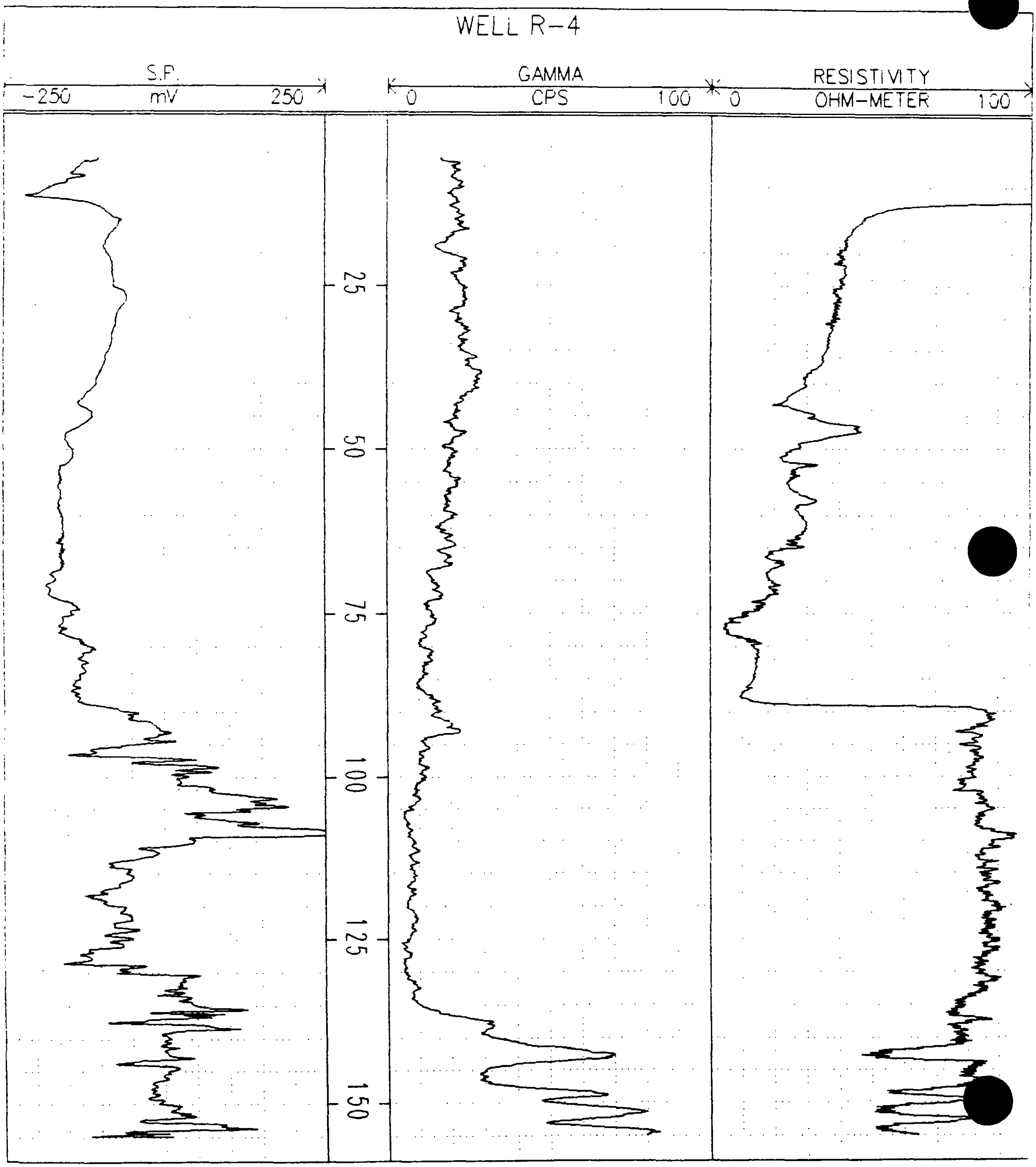
STATE: OHIO
COUNTY: STARK

COORDINATES:
N:
E:
ELEVATION: KB:
DF:
GL:

EDI JOB NO: 901
WELL: R-4
LOCATION: MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int	0'	Fluid Nature	WATER
Top Logged Int.	155'	Fluid Viscosity	
Footage Logged	155'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING


WELL R-4
S.P.
-250 mV 250
GAMMA
0 CPS 100
RESISTIVITY
0 OHM-METER 100
25
50
75
100
125
150

WESTON
MANAGERS DESIGNERS CONSULTANTS

APPENDIX I

CASING SEAT FALLING HEAD TEST DATA

EKCO PACKER TEST APRIL, 1991
R-2 GROUT SEAL FALLING HEAD TEST

TIME(min)	DTW(ft)
0.00	30.06
1.00	4.28
1.76	6.68
2.58	9.35
3.15	10.97
3.49	11.87
3.88	12.85
4.44	14.21
4.81	15.02
5.06	15.52
5.46	16.28
5.87	17.08
6.45	17.83
6.80	18.58
7.48	19.40
7.91	20.16
8.30	20.49
8.75	20.97
8.95	21.20
9.62	22.04
10.05	22.39
10.36	22.69
11.00	23.19
11.37	23.43
12.35	24.98
13.85	24.63
14.25	25.00
14.50	25.05
15.00	25.26
15.55	25.50
15.90	25.57
16.13	25.62
16.37	25.67
16.75	25.75
17.19	25.89
17.40	25.91

TIME(min)	DTW(ft)
17.61	25.98
17.86	26.02
18.13	26.07
19.03	26.24
19.67	26.34
20.28	26.38
20.57	26.50
21.29	26.53
21.73	26.58
23.17	26.74
23.90	26.78
23.90	26.78
24.35	26.78
25.70	26.88
26.40	26.92
27.33	26.96
27.86	26.99
28.11	27.01

** 30-Apr-91**

SLUG TEST ANALYSIS

Site location: EKCO
Well ID: R-2

Test No.:ZONE 3 Step No.:FALLING HEAD

Total well depth:	49	feet		
Depth to water:	30.06	feet		
Screen length (Le):	2	feet		
Well diameter:	6	inches		
Borehole diameter:	6.5	inches	Rc= 0.25	feet
Sat. thickness (Lw):	18.94	feet	rw= 0.2708	feet

From type curve:
Where Le/rw=7.3846
C= 1

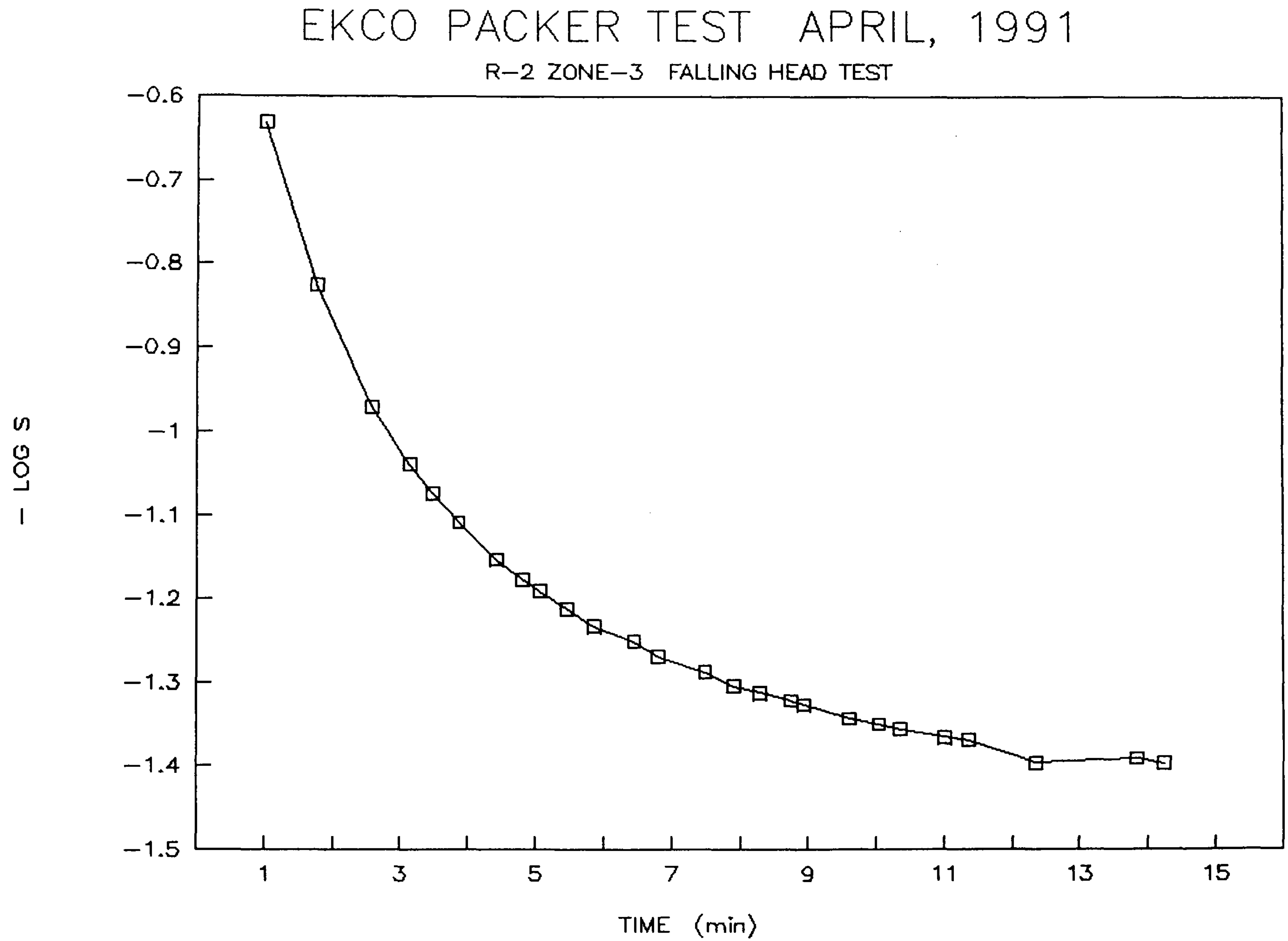
ln(Re/rw)= 2.5356

Bouwer and Rice Results:

r squared = 0.9894

Hydraulic conductivity = 6.29 ft/day

Effective radial distance
of slug test = 3.4 feet



EKCO PACKER TEST APRIL, 1991
R-2 ZONE-3 FALLING HEAD TEST
- LOG S
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
1
3
5
7
9
11
13
15
TIME (min)

APPENDIX J

DRILLER LOGS FOR WELLS R-1 THROUGH R-4, W-1, AND W-2

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

R-1

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 1 - 6"
Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 25, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
41 ft.	Wash	41 ft.		
3 ft.	Sandy Shale	44 ft.		
22 ft.	Sandstone (white, hard & dry)	66 ft.		
2 ft.	Shale	68 ft.		
11 ft.	Sandstone	79 ft.		
4 ft.	Shale	83 ft.		
8 ft.	White Sandstone	91 ft.		
12 ft.	White Sandstone with Black Streaks	103 ft.		
4 ft.	Shale	107 ft.		
15 ft.	Yellow Sandstone	122 ft.		
17 ft.	Yellow & Brown Sandstone	139 ft.		
8 ft.	White Sandstone	147 ft.		
2 ft.	Shale	149 ft.		
16 ft.	White Sandstone	165 ft.		
10 ft.	Shale - Sandy Streaks	175 ft.		

Cased to 42 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
60 - 80 ft.	38.0 ft.	0.34 gpm per foot of drawdown
80 - 100 ft.	38.0 ft.	0.38 gpm per foot of drawdown
100 - 120 ft.	42.0 ft.	0.65 gpm per foot of drawdown
120 - 140 ft.	39.7 ft.	5.0 gpm per foot of drawdown
140 - 160 ft.	32.5 ft.	less than 0.04 gpm per foot of drawdown
160 - 170 ft.	37.5 ft.	less than 0.04 gpm per foot of drawdown

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

R-2

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 2 - 6"
Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 29, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
44 ft.	Top	44 ft.		
40 ft.	Sandstone	84 ft.		
3 ft.	Shale	87 ft.		
22 ft.	Sandstone (brown)	109 ft.		
2 ft.	Shale	111 ft.		
6 ft.	Sandstone (brown)	117 ft.		
3 ft.	Sandstone (reddish)	120 ft.		
23 ft.	Sandstone (brown with black streaks)	143 ft.		
26 ft.	Sandstone (white)	169 ft.		
10 ft.	Shale	179 ft.		

Cased to 46 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
46.5 - 179 ft.	43.0 ft.	0.91 gpm per foot of drawdow
60 - 80 ft.	34.8 ft.	0.91 gpm per foot of drawdow
80 - 100 ft.	36.5 ft.	0.22 gpm per foot of drawdow
100 - 120 ft.	39.5 ft.	0.17 gpm per foot of drawdow
120 - 140 ft.	34.8 ft.	0.11 gpm per foot of drawdow
140 - 150 ft.	39.1 ft.	0.10 gpm per foot of drawdow

Test hole filled to 150 feet during pumping.

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

R-3

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 3 - 6" Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 30, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
32 ft.	Top	32 ft.		
16 ft.	White Sandstone	48 ft.		
8 ft.	Shale	56 ft.		
13 ft.	Sandstone (damp - brown)	69 ft.		
12 ft.	Sandy Shale	81 ft.		
36 ft.	Sandstone (brown)	117 ft.		
[illegible]1 ft.	Sandstone (reddish)	128 ft.		
2 ft.	Shale	130 ft.		
13 ft.	Sandstone (brown)	143 ft.		
3 ft.	Shale	146 ft.		
24 ft.	Sandstone (white)	170 ft.		
5 ft.	Shale with Sandy Streaks	175 ft.		

Cased to 37 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
37.5 - 160 ft.	41.2 ft.	0.63 gpm per foot of drawdown
60 - 80 ft.	44.5 ft.	0.32 gpm per foot of drawdown
80 - 100 ft.	44.6 ft.	0.47 gpm per foot of drawdown
100 - 120 ft.	39.5 ft.	0.10 gpm per foot of drawdown
120 - 140 ft.	42.0 ft.	0.15 gpm per foot of drawdown
140 - 160 ft.	35.6 ft.	0.01 gpm per foot of drawdown

Test hole filled to 160 feet during pumping.

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. R-4

6" Rotary Hole

DRILLED BY John King and McKay & Gould DRILLER COMPLETED July 19, 19 85

LOCATION Northeastern corner of property, approximately 250 ft. east of R-2

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
21 ft.	Clay & Shale	21 ft.		
10 ft.	Clay, Sand & Stones	31 ft.		
19 ft.	Clay, Gravel & Sand	50 ft.		
32 ft.	Sand, Gravel & Clay	82 ft.		13' 0"
10 ft.	Clay, Sand & Gravel	92 ft.		
37 ft.	Sandstone	129 ft.		13' 8"
1 ft.	Shale	130 ft.		
17 ft.	Sandstone	147 ft.		13' 8"
2 ft.	Shale	149 ft.		[illegible]
11 ft.	Sandstone	160 ft.		[illegible]
5 ft.	Shale	165 ft.		[illegible]

Cased to 92 feet with 6" pipe.

Test hole pumped at the following depths.

No contaminati

Depth	Static Water Level	Specific Capacity
50'	13' 0"	- -
60'	13' 0"	- -
90' - 100'	13' 8"	1.5 gpm per ft. of drawdown
100' - 120'	13' 8"	0.8 gpm per ft. of drawdown
120' - 140'	13' 8"	0.6 gpm per ft. of drawdown
140' - 160'	13' 8"	2.1 gpm per ft. of drawdown

W-1
South well

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

DRILLED FOR Massillon Aluminum Company, Massillon, Ohio HOLE NO. 1 - 12" Well

DRILLED BY Herb Dyer DRILLER COMPLETED April 14, 1951

LOCATION South side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
19 ft.	Clay, stones	19 ft.		
6 ft.	Clay	25 ft.		
46 ft.	Shale	71 ft.		
12 ft.	Yellow sandrock	83 ft.		28 ft.
13 ft.	Gray shale	96 ft.		28 ft.
49 ft.	Yellow sandrock	145 ft.		28 ft.
[illegible] ft.	White sandrock	168 ft.		28 ft.
[illegible] ft.	Shale, sandy shells	200 ft.		28 ft.
25 ft.	Shale	225 ft.		28 ft.

Total depth 225 ft.

Well cased with 29'-3" of 12" - 51 lb. steel drive pipe with steel drive shoe.

Initial test 125 g.p.m. at 110 ft. pumping level

Shot well as follows:

50 lb. 60% Dynamite at 160 ft.
50 lb. 60% Dynamite at 145 ft.
50 lb. 60% Dynamite at 130 ft.
50 lb. 60% Dynamite at 115 ft.

Final test 500 g.p.m. at 105 ft. pumping level
550 g.p.m. at 120 ft. pumping level

W-2

East we

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

DRILLED FOR Ekco Products Company, Massillon Aluminum Division Massillon, Ohio HOLE NO. 2 - 12" Wel

DRILLED BY Herb Dyer DRILLER COMPLETED January 30, 1953

LOCATION East side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
12 ft.	Cinders, fill	12 ft.		
23 ft.	Clay, stones	35 ft.		
12 ft.	Sand, gravel, clay	47 ft.		
21 ft.	Clay, gravel	68 ft.		
8 ft.	Broken sandrock, shale	76 ft.		
9 ft.	Shale	85 ft.		
60 ft.	Sandrock, yellow	145 ft.		
23 ft.	Sandrock, gray	168 ft.		
22 ft.	Shale with streaks of sandrock	190 ft.		
35 ft.	Shale, gray	225 ft.		

Water level - 34 ft.

Well cased with 84'-8" of 12"-51# steel drive pipe, fitted with drive shoe.

Well shot 4 times, each shot was 50# of 50% N.G. dynamite. Shots were at 125', 137', 149', and 161'.

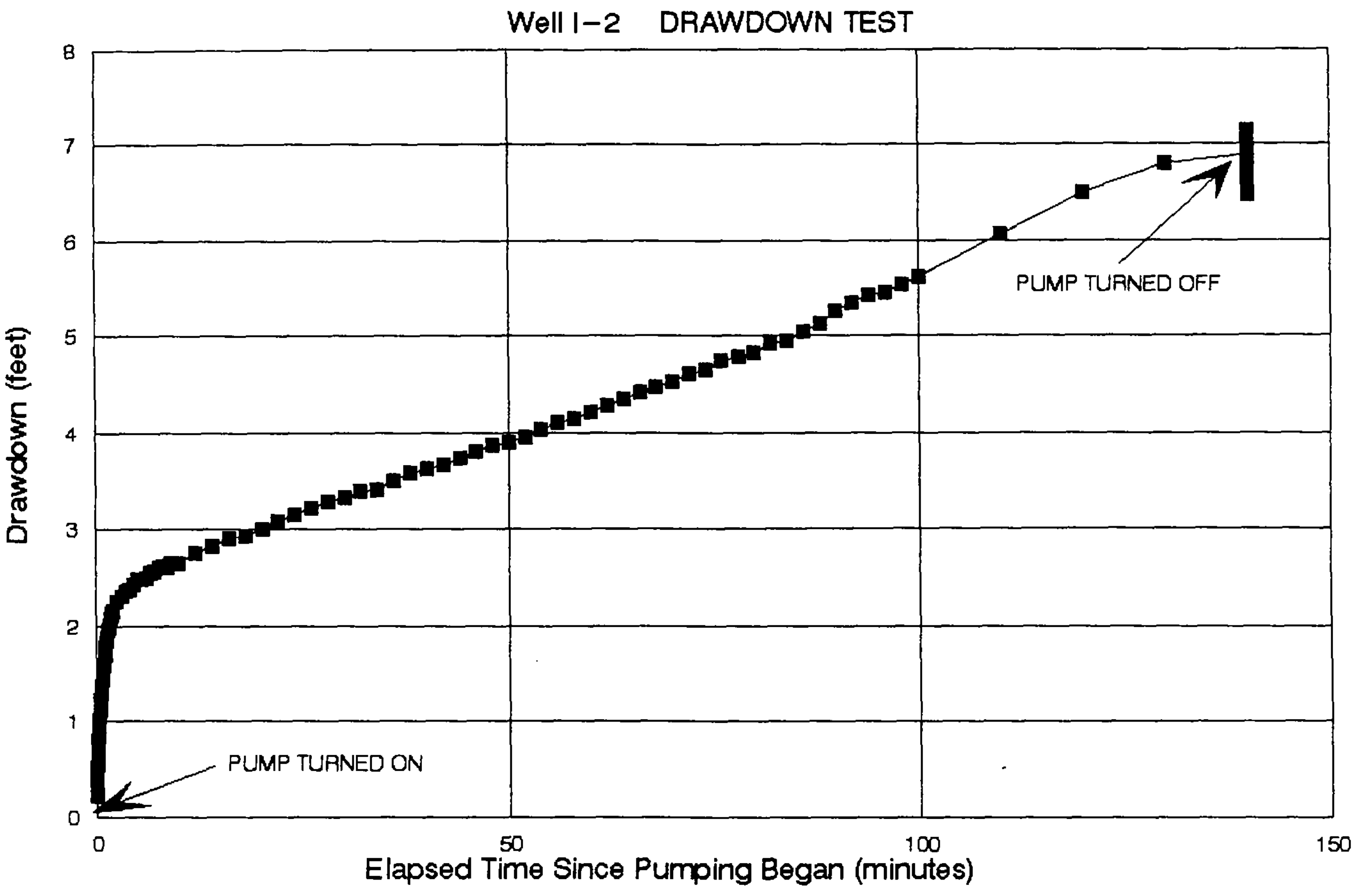
After completion, top of 12" casing was extended 6 ft. above surface and this will be filled, therefore depth of well will be approximately 231 ft., and overall length of 12" casing will be approximately 90'-8".

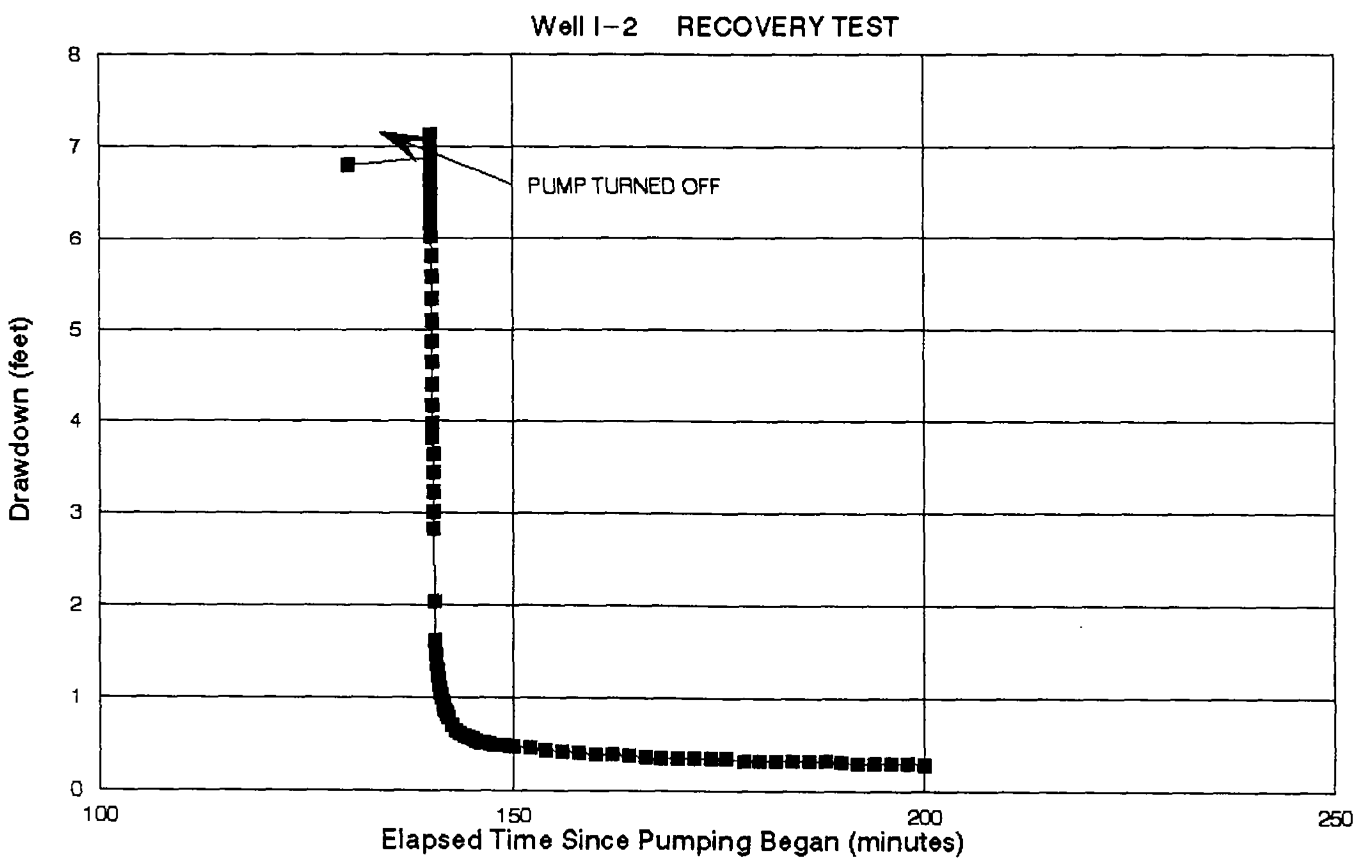
WESTON
MANAGERS DESIGNERS CONSULTANTS

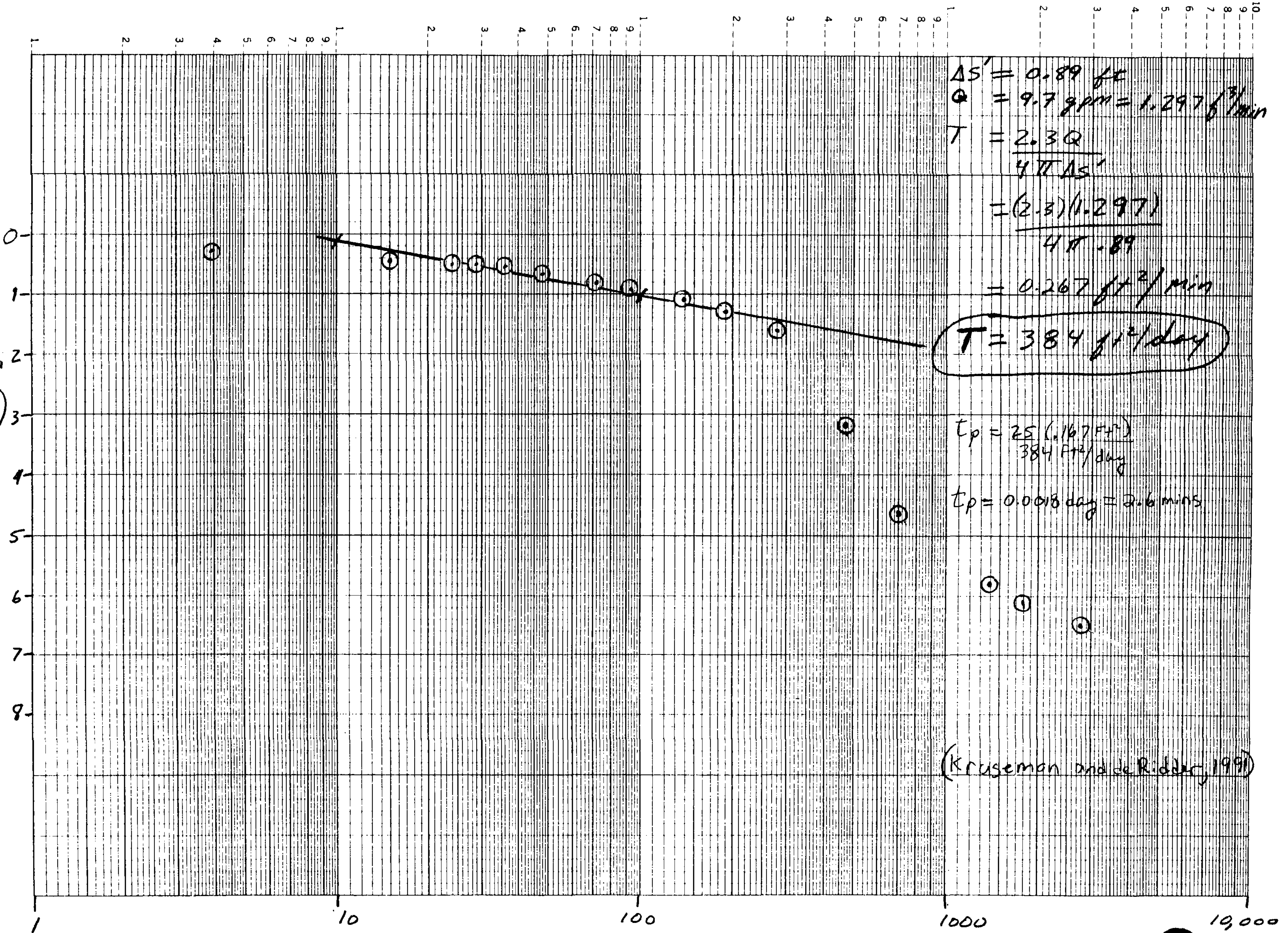
APPENDIX K

PUMP TEST DRAWDOWN-RECOVERY CURVES

EKCO PUMP TESTS

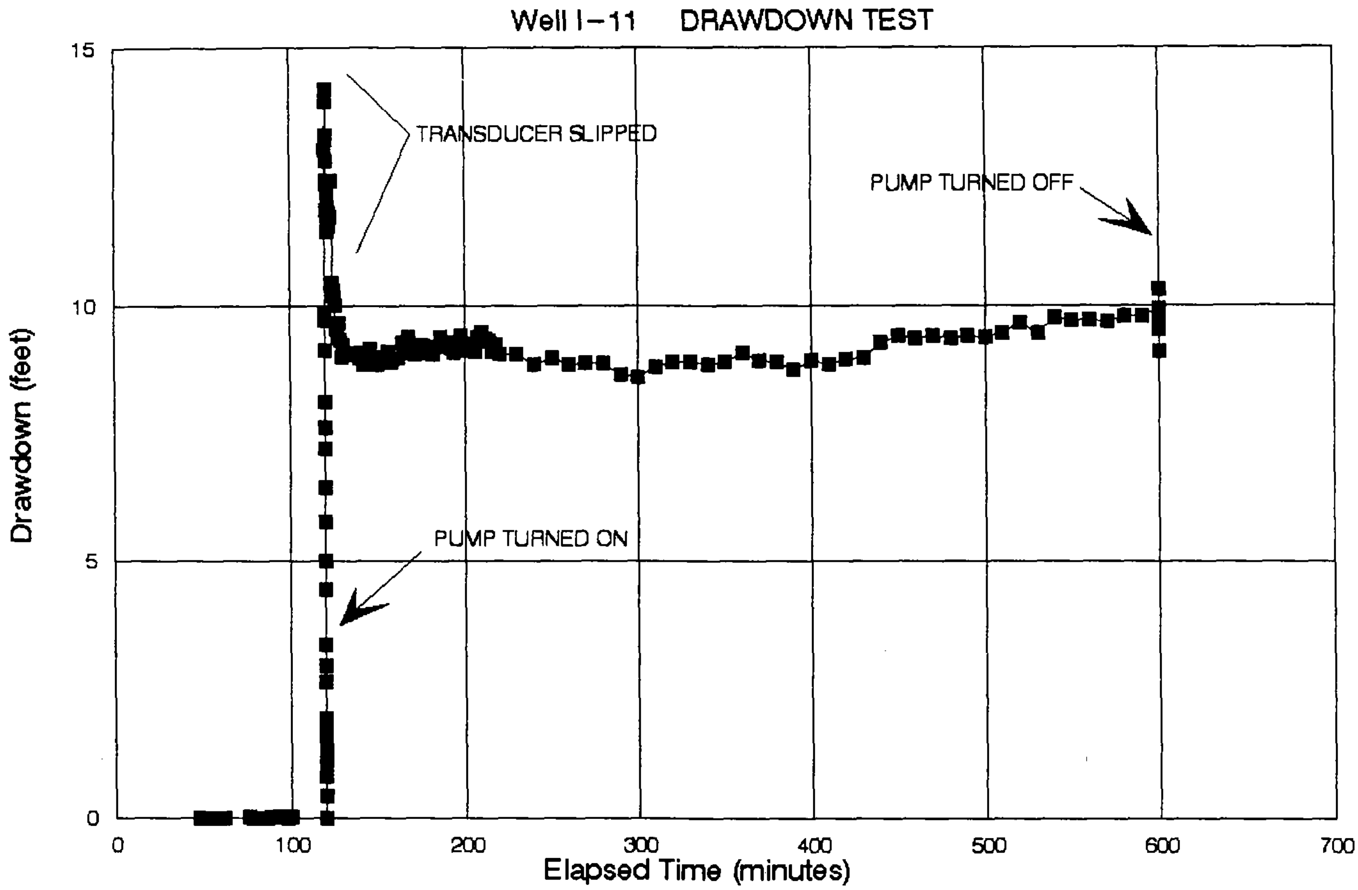


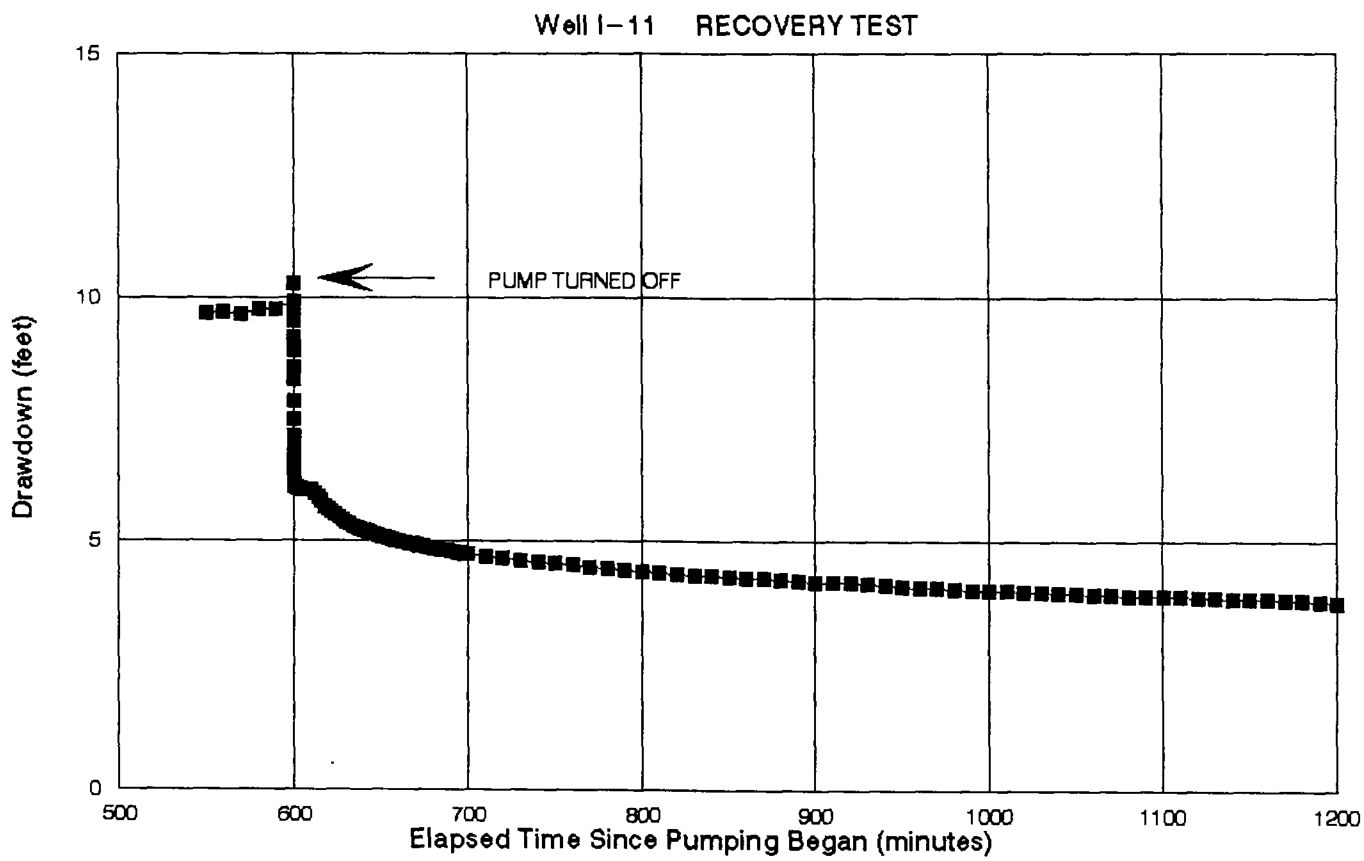


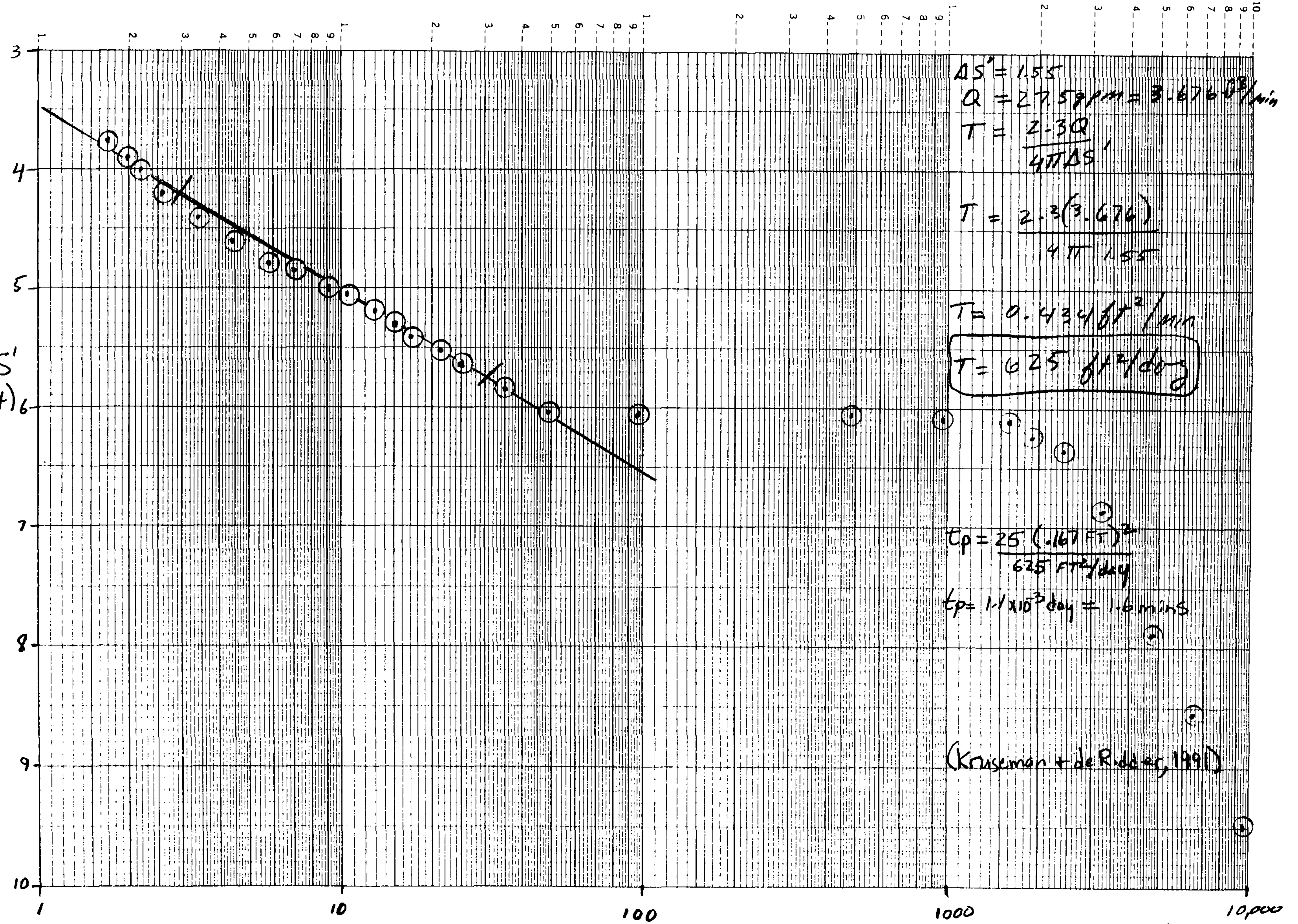


T-2 (3rd test) recovery

EKCO PUMP TESTS

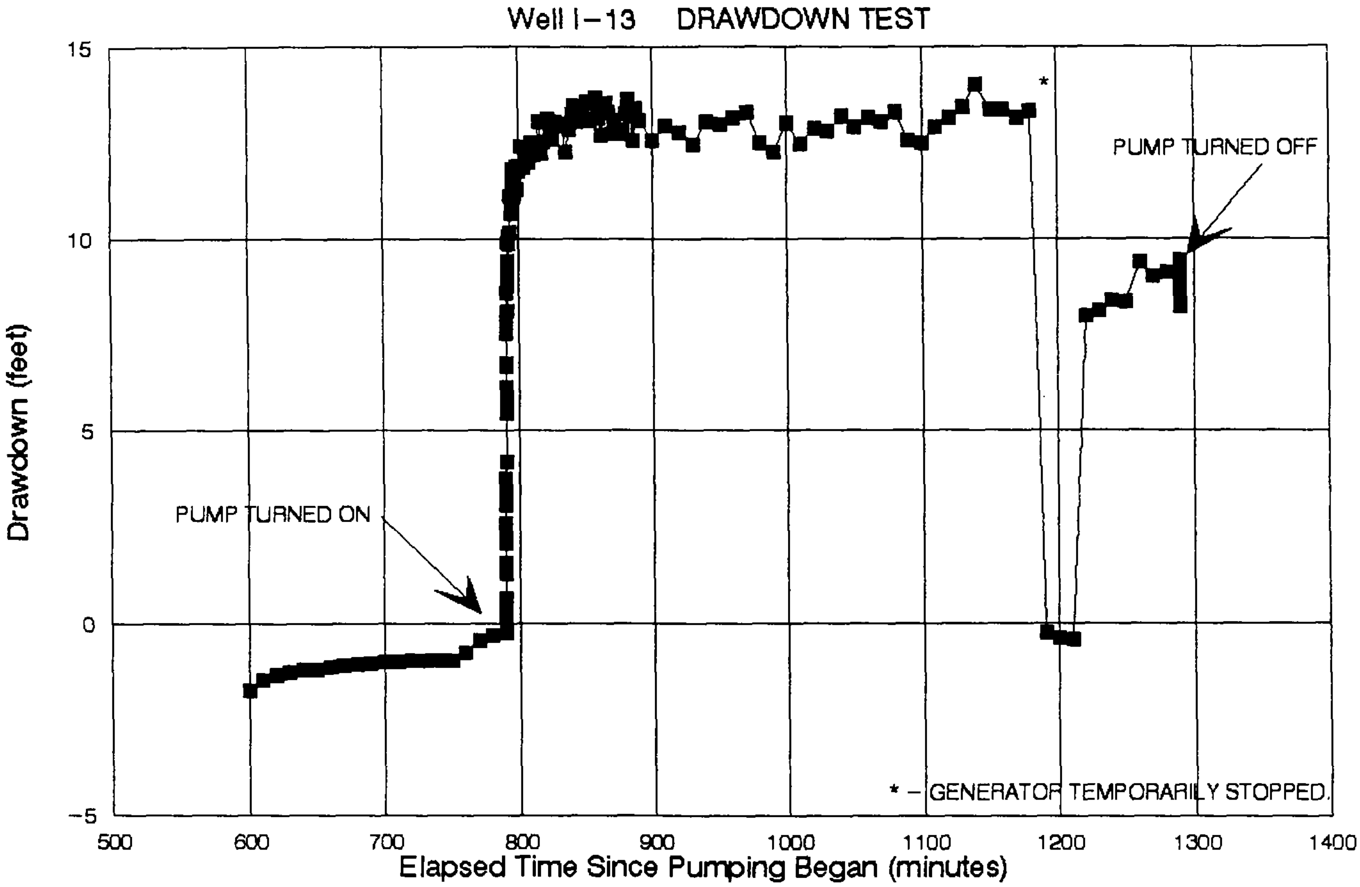


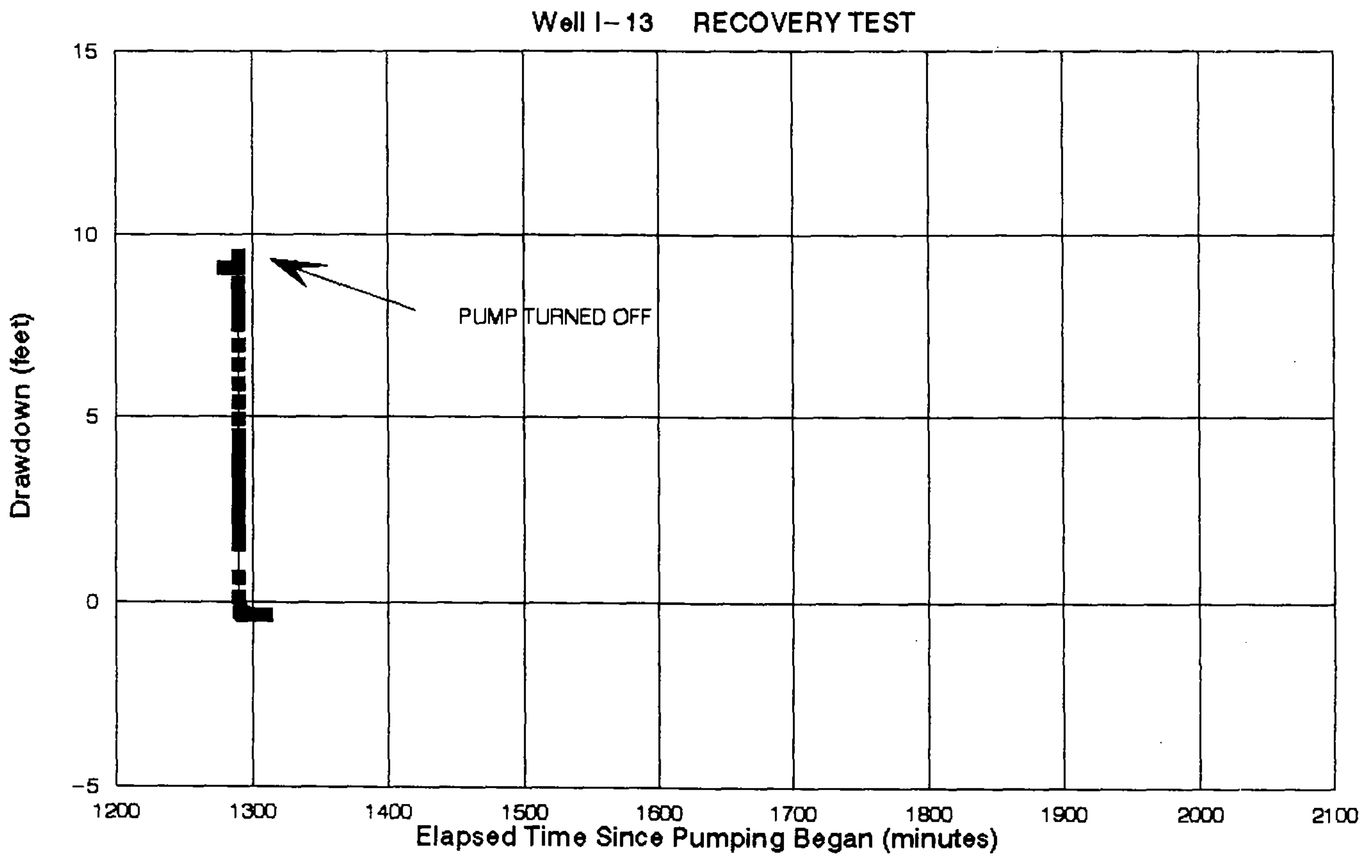


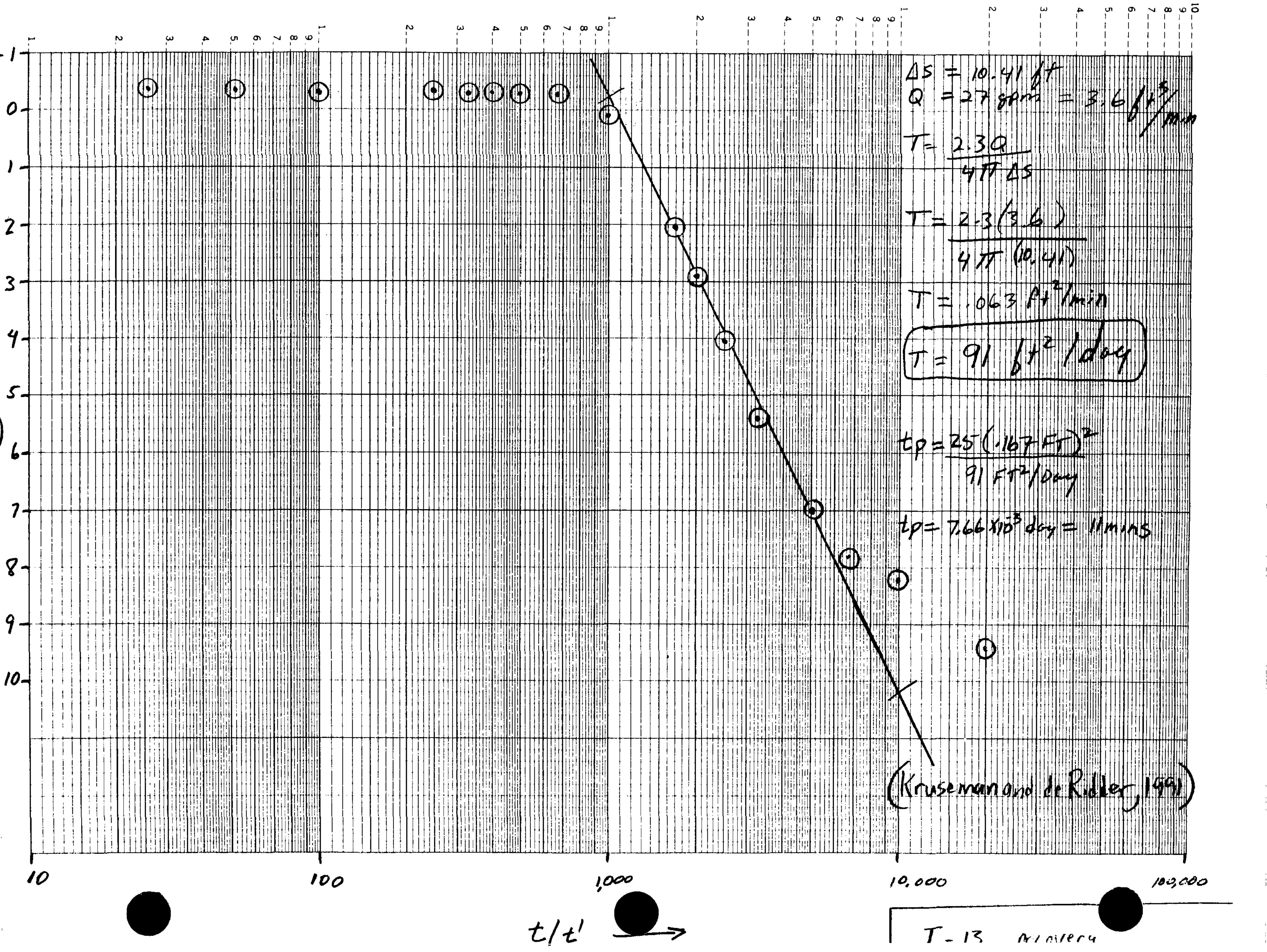


I-11 (1st test) recovery

EKCO PUMP TESTS

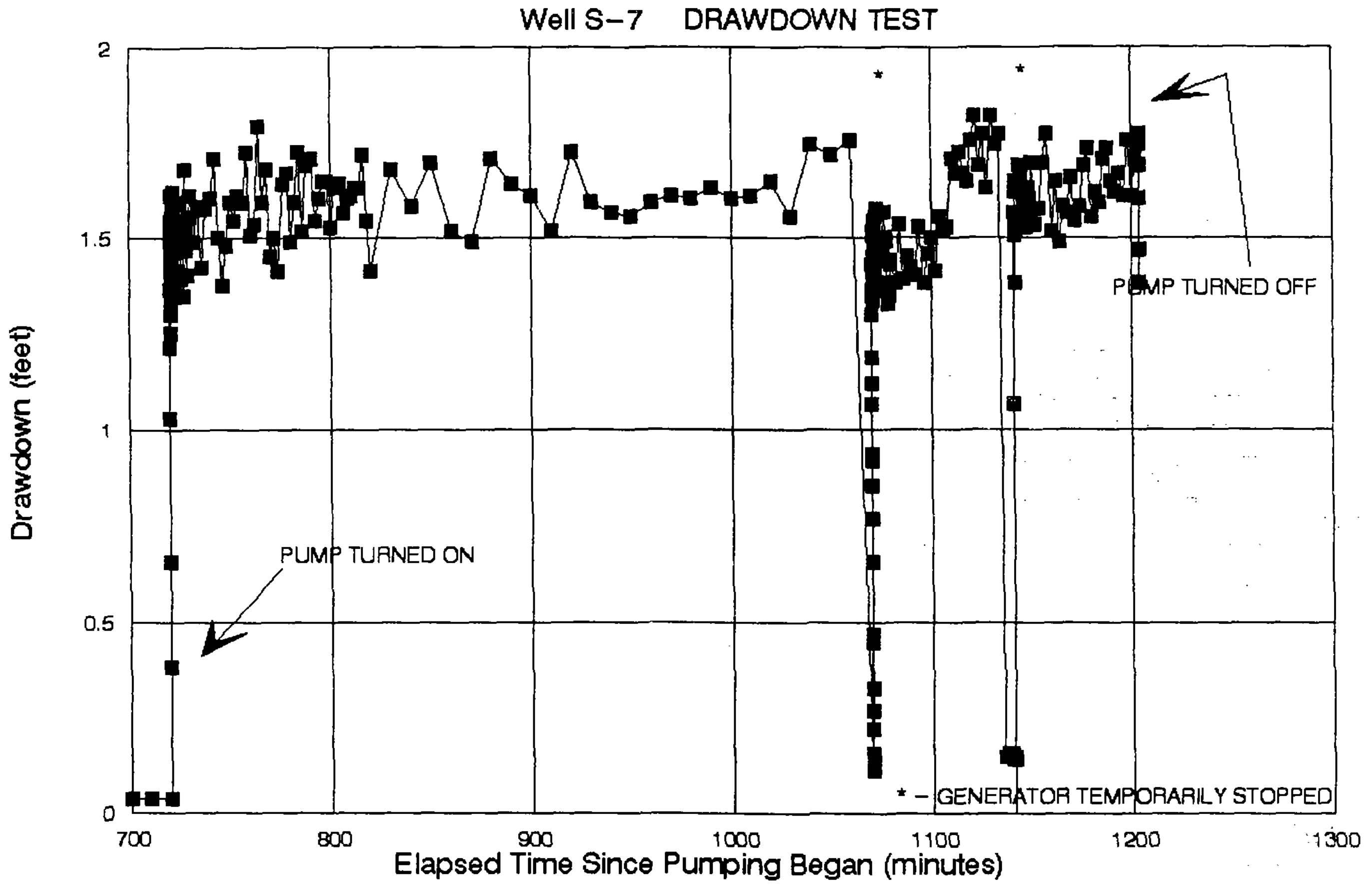


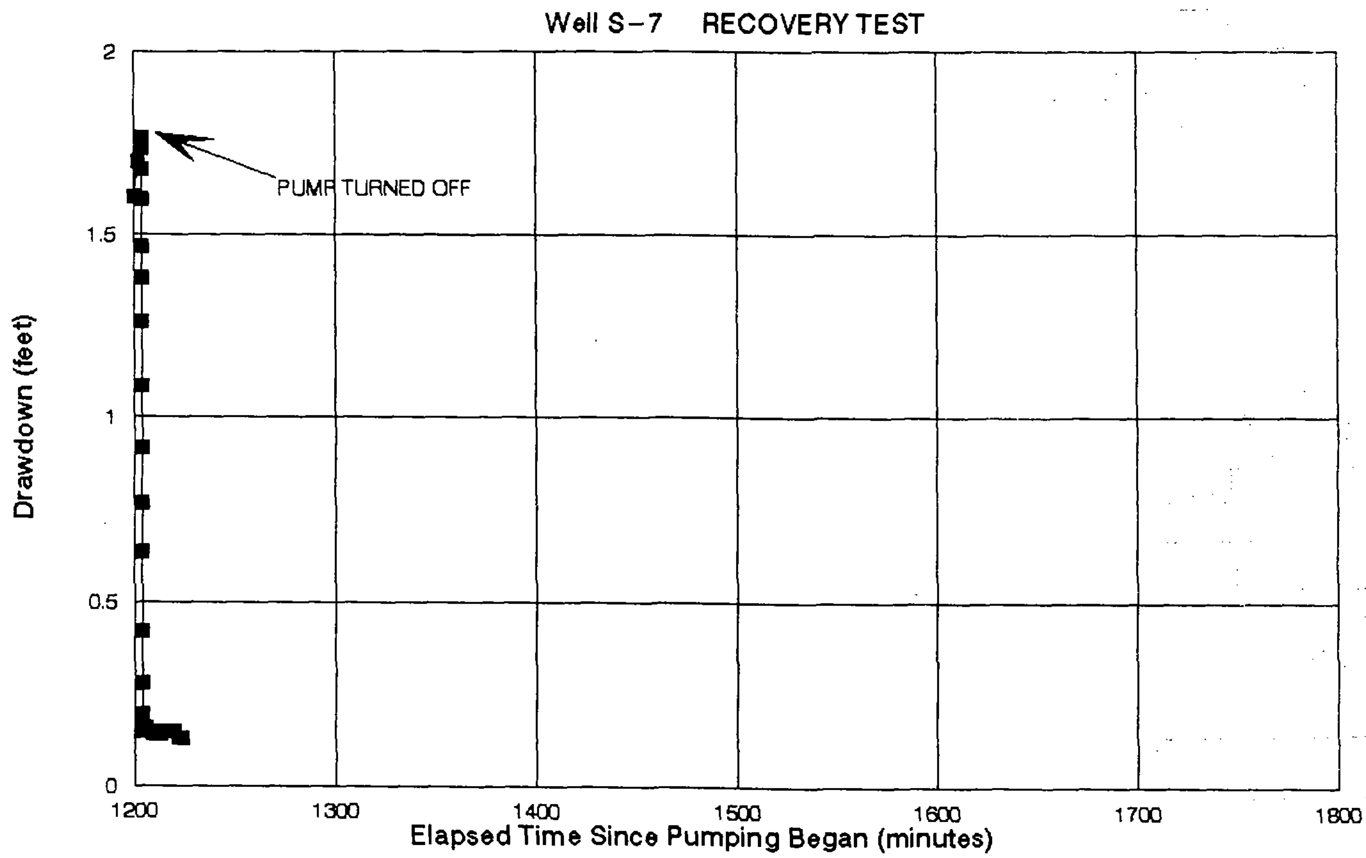




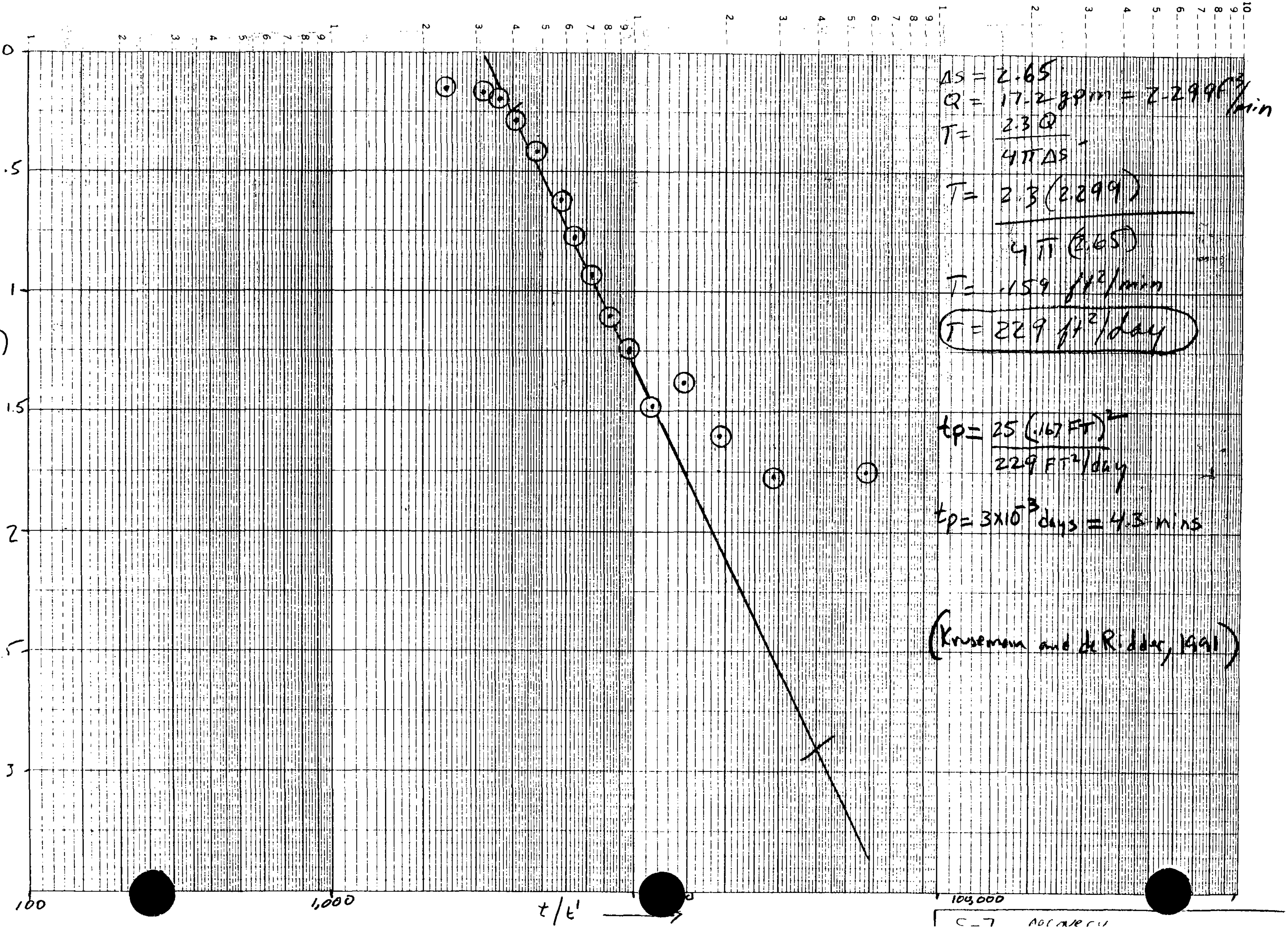
$\Delta s = 10.41$ ft
$Q = 27$ gpm $= 3.6$ ft³/min
$T = \frac{2.3Q}{4\pi \Delta s}$
$T = \frac{2.3(3.6)}{4\pi(10.41)}$
$T = .063$ ft²/min
$\boxed{T = 91 \text{ ft}^2/\text{day}}$
$t_p = \frac{25(.167 \text{ FT})^2}{91 \text{ FT}^2/\text{Day}}$
$t_p = 7.66 \times 10^{-3}$ day $= 11$ mins
(Kruseman and de Ridder, 1991)
10
100
1,000
10,000
100,000
t/t'
T-13 Recovery

EKCO PUMP TESTS

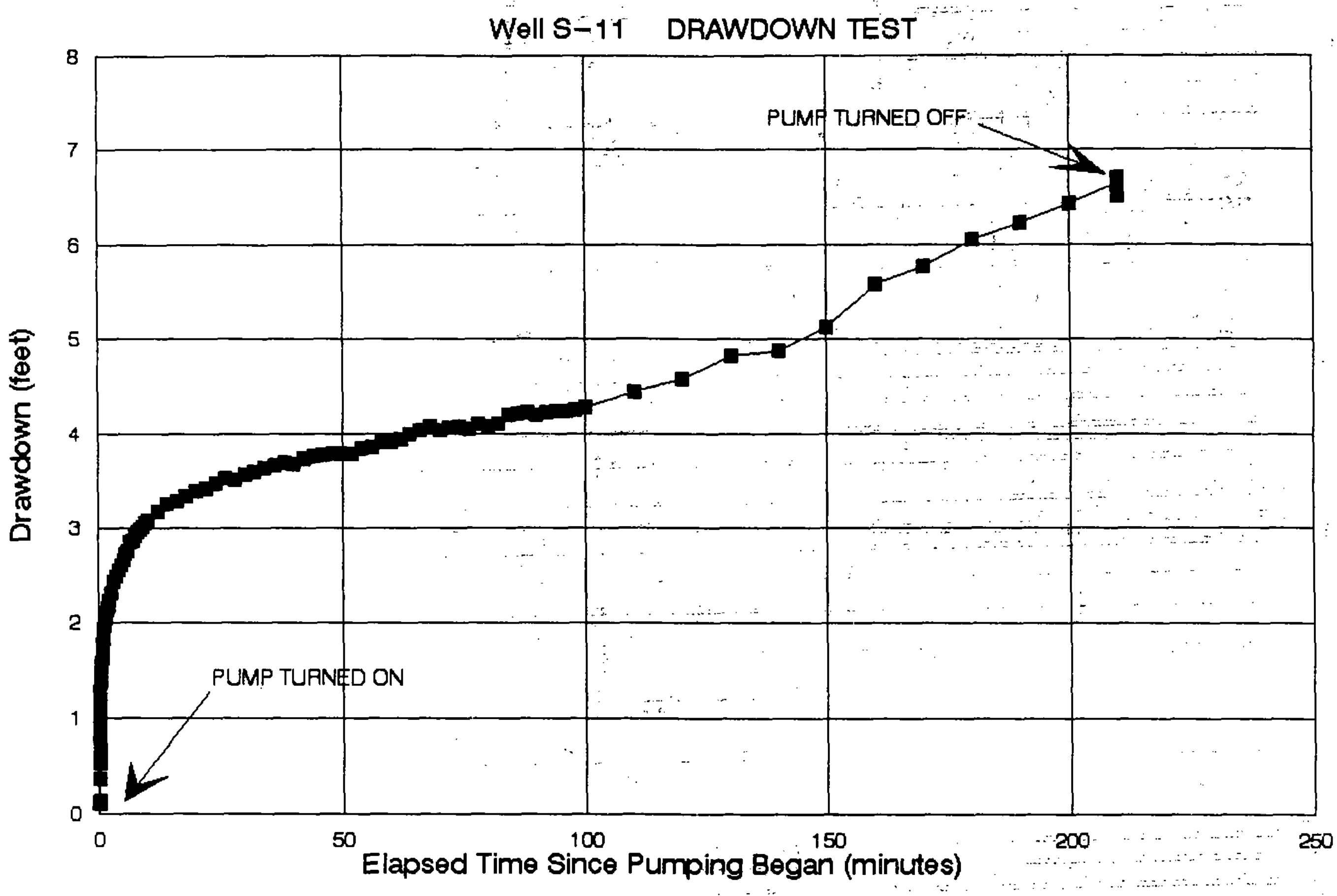


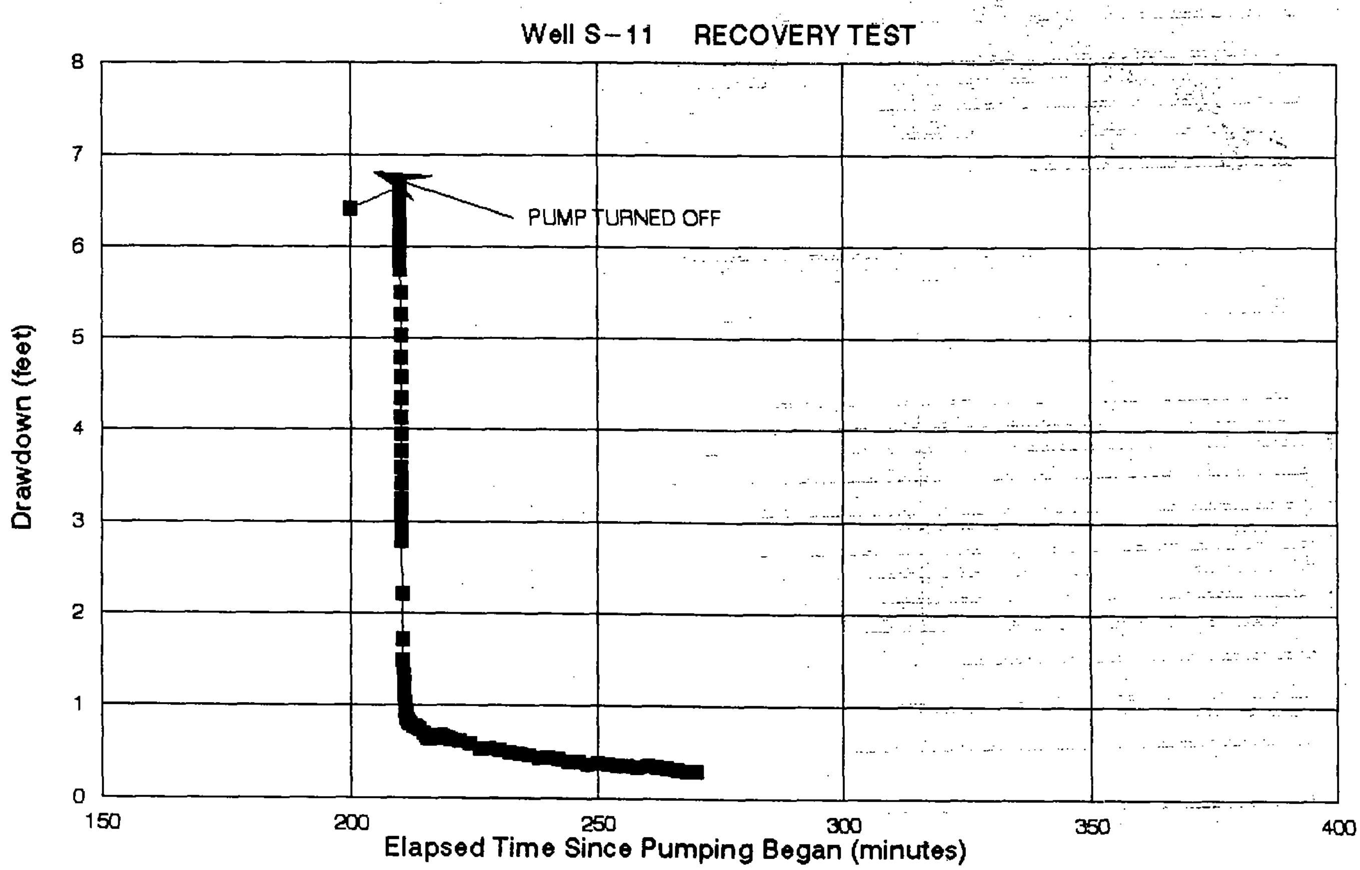


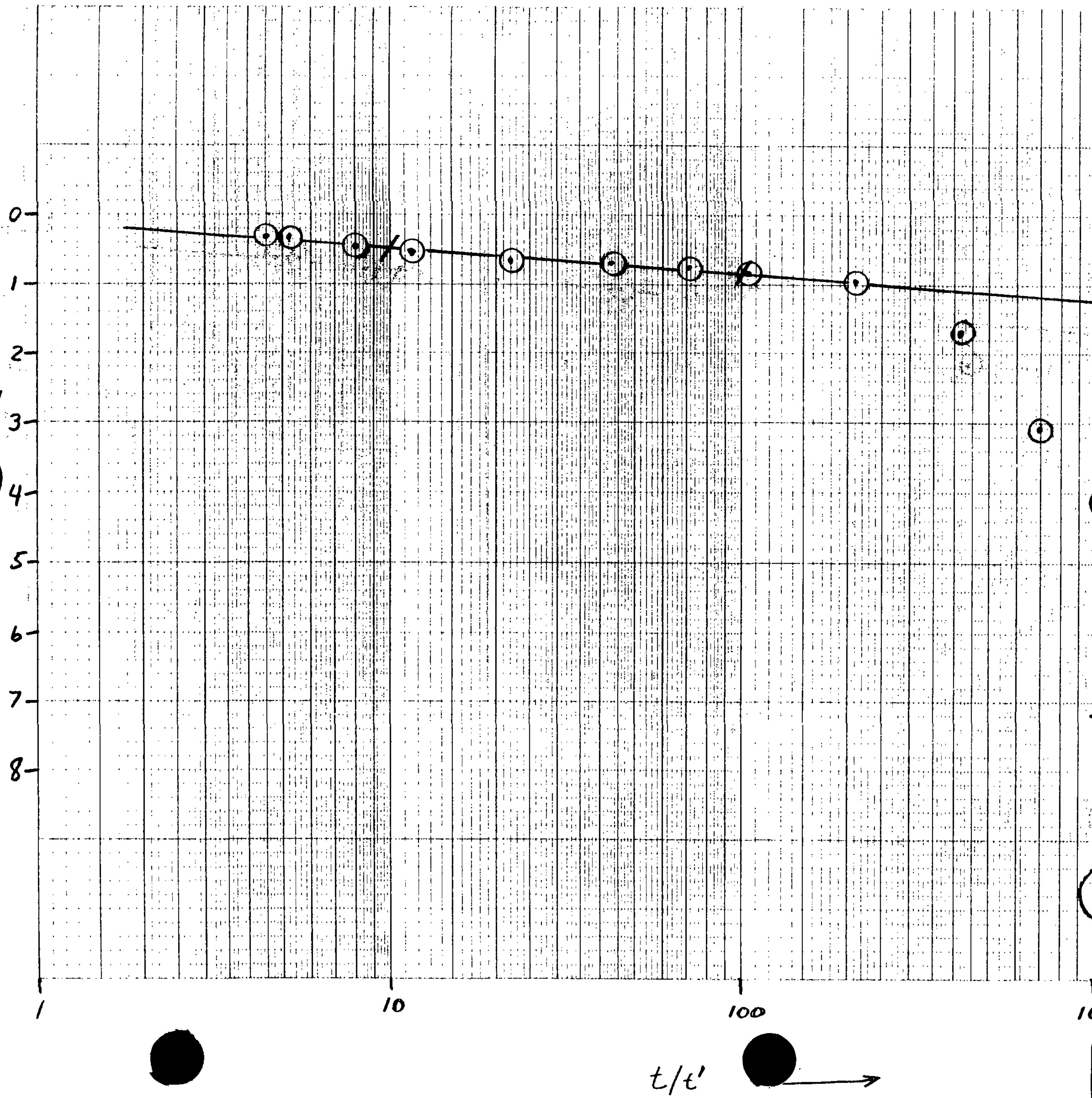
K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6010



EKCO PUMP TESTS







$\Delta s' = 0.35$

$Q = 9.1\,gpm = 1.217\,ft^3/min$

$T = \dfrac{2.3Q}{4\pi \Delta s'}$

$T = \dfrac{2.3(1.217)}{4\pi(.35)}$

$T = \dfrac{2.3(1.217)}{4\pi \cdot .35}$

$T = .636\ ft^2/min$

$\boxed{T = 916.1\ ft^2/day}$

$t_p = \dfrac{25(.167\,FT)^2}{916\,FT^2/day}$

$t_p = 7.6\times10^{-4}\,day = 1.09\,mins$

(Kruseman and de Ridder, 1991)

S-11 (2nd test) re…

U.S. ENVIRONMENTAL PROTECTION AGENCY

TECHNICAL ENFORCEMENT SUPPORT
AT
HAZARDOUS WASTE SITES

TES X

CONTRACT NO. 68-W9-0007
WORK ASSIGNMENT NO. CO5026

TECHNICAL REVIEW COMMENTS
GROUND WATER QUALITY ASSESSMENT REPORT
FOR
EKCO HOUSEWARES

U.S. EPA REGION V

METCALF & EDDY, INC.
PROJECT NO. 150026-0001-626

WORK PERFORMED BY:

METCALF & EDDY, INC.
2800 CORPORATE EXCHANGE DRIVE, SUITE 250
COLUMBUS, OHIO 43231

APRIL 2, 1990

Metcalf & Eddy's Assessment of the Adequacy of the PRP's Responses to U.S. EPA List of Deficiencies and Comments of October 26, 1989 Concerning the "Groundwater Quality Assessment Report for EKCO Housewares."

1. Request for additional data on "large, inactive municipal landfill":

   Response (Sec. 1.2, p. 1.2) gives more, but very general, data. The sources of these data should have been given so that we could judge the adequacy of effort made to run this down. The landfill is said to be "just east of the Ohio Water Service facility," presumably near Ohio Water Service's contaminated and abandoned well. I should think Ekco would want the history of this site checked out thoroughly.

2. Response adequate.

3. Response adequate.

4. The report, pp. 1-6, paragraph 2, should state that the lagoon was used intermittently from 1981 through 1984. The report does not "describe the procedures that were followed when the lagoon was taken out of service," asked for by U.S. EPA.

5. Tables 1-1 and 1-2, and Figures 1-3 and 1-4 have been added, representing data from preliminary closure plan by Floyd Brown Associates, June 1986.

6. Figures 1-3 and 1-4, showing location of Floyd Brown Associates Phase I and Phase II soil borings, are no doubt intended to meet this requirement.

7. Response adequate.

8. Response adequate.

9. Response adequate.

10. Response adequate.

11. M&E can not address this issue now because the logs in question, those of W-1 and R-1, are not in Appendix C.

12. This comment has not been addressed. Section 2.2 has not been changed as stated.

13. Response is inadequate. We know why the "L" wells were installed; EPA's question remains unanswered.

14. Response adequate.

15. Response adequate.

16. Response adequate.

17. Response adequate.

18. Question not answered fully, but it is not of major importance.

19. The point source map is new Figure 3-4 (p. 3-7). It should have been identified in response item.

20. Figure 3-2 has been revised as stated (see new Figure 3-3), but it is still impossible to read many of the sampling point identification numbers.

21. This comment is not addressed appropriately. The reason why the survey was not extended (see old Report, p. 3-6, 1st line) is simply avoided in the new version (see p. 3-2, next-to-last paragraph).

22. Evidently the response refers to new Figure 3-4 (point source locations).

23. The text has been revised by ignoring the occurrence of the "relatively minor soil VOC's."

24. Evidently new Figure 3-4.

25. Response adequate.

26. Weston still has not supplied any data on off-site background levels.

27. Weston misses the point in the question, and fails to address it. However, the revision is an improvement over the earlier version.

28. Figure references have been corrected. The wide disparity in constituent values shown in Figures 3-5 through 3-11 made evident the fact that extending isoconcentration contours over wide areas between data points can be very misleading. See, for example, Figure 3-6.

29. Response adequate.

30. Response adequate.

31. Response is misleading -- EPA didn't ask that the statement be deleted; they said only that it was unsupported.

32. Response adequate.

33. Response adequate.

34. Response adequate.

35. See revised statement, p. 3-26, 1st paragraph. It isn't the method that is inaccurate, but the measurements themselves. Why not say so?

36. Response adequate.

37. This response is incorrect. A storativity range of 0.002 to 0.0001 does not lie "midway between those of a confined and unconfined aquifer." A confined aquifer, according to Lohman (Prof. Paper 708, p. 8), has a storativity range of 0.00001 to 0.001. (This range is also stated Johnson Ground Water and Wells, 1966 Edition, p. 102.) It is also argued that the aquifer is heterogeneous but not anisotropic. Isotrophy means, roughly, that the permeability of an aquifer is the same in all directions. (For a more rigorous definition, see Groundwater,

by Freeze and Cherry, 1979, p. 30.) If they have evidence to show that this aquifer is heterogeneous and at the same time isotropic, we would like to see it.

38. The reference is to Johnson Ground Water and Wells, and it is being misinterpreted. As M&E stated, in the 1966 edition, the range for artesian aquifers is given as 0.00001 to 0.001. For water table aquifers, the range is given as 0.01 to 0.35. Does the range 0.002 to 0.0001 lie "midway" between the quoted ranges? Perhaps, but it is tilted towards the range for confined aquifers.

    The authors' (PRPs) response to this item and to other points raised by U.S. EPA, make it clear that the EPA comments are not being received in the spirit of helpfulness in which they were offered, but appear to be resented by the authors, and are complied with grudgingly and in a manner suggestive of dissemblance.

39. Response adequate.

40. Response adequate.

41. Response adequate.

42. M&E disagrees with this response. M&E did not say that the size of the cone is independent of the pumping rate, but rather the rate at which it spreads. The authors state that a change in the pumping rate will change the slope of the semilog plot, and "hence, the size of the cone." Of course, it will change the "size" of the cone, but not the rate of growth. Consider for instance a distance-drawdown plot of the cone of depression caused by pumping a well for one day at, say, 100 gallons per minute. The curve can be extended to the point of zero drawdown. Doubling the pumping rate for the same period of pumping will double the drawdown everywhere on the curve, including the point of zero drawdown. Twice zero is still zero. Thus, the size (volume) of the cone depends on the pumping rate, but the rate at which the cone spreads does not.

    The revised text omits reference to the pumping rate (see p. 3-22, 5th paragraph), which further highlights the inadequacy of the response to comment 42.

43. Response adequate.

44. Response adequate.

45. Response adequate.

46. Response adequate.

47. Response adequate.

48. Response adequate.

49. Although the reference to "normalizing the pressure head" has been omitted, there are still questions. 1) Where are the "wells screened in the more permeable glacial sands and gravels" (p. 3-37, 4th paragraph) with respect to the lagoon wells? If these "sand and gravel" wells are lower in elevation, one might expect them to show lower water levels. The response to the second part of M&E's comment questioning the reason for using a computer simulation in this situation is not answered. Instead, a general statement is provided about "providing a tool, etc." M&E does not consider such general statements responsive; M&E (and EPA) want to know how use of computer simulation is justified in this instance, how accurate the results are expected to be (something about the cost-benefit ratio), and how the results will be used in the eventual clean-up of the site?

50. Response adequate.

51. If the five closely-spaced lagoon wells are the only "reliable wells screened in the fill," how will results of computer simulation be verified (see response to comment 49)?

52. Response adequate.

53. Weston is wrong in their response. The formula supplied is based on drawdown *vs.* distance, not drawdown *vs.* time, as they state. And again, M&E said nothing about the size of the cone being independent of the pumping rate, only that the lateral growth (extent) of the cone is independent of the pumping rate. This point is too well established in the literature to argue.

54. Weston gives up rather easily on these points. The contours in Figure 3-19 (lagoon wells) and in Figure 3-20 (interface wells) have been revised, although those in Figure 3-19 still do

not sufficiently show the bending effect caused by the pumping of the plant wells. The contours in Figure 3-20 have been radically altered over the original version, and now show these pumping effects.

Thus, all three contour maps (lagoon wells, interface wells, and pumping wells) now show the same general configuration, as one would expect, inasmuch as they represent interconnected parts of the same ground water system. Unfortunately, however, Weston has not corrected the first paragraph in Section 3.8.2.2, p. 3-38, which states that each of the three zones has "significantly different ground water flow patterns."

Weston postulates existence of a ground water divide on the interface wells contour map (Figure 3-20), based on the water level in P-4. There probably is such a divide, and additional data, which they say will be collected (p. 3-39, paragraph 4), should better define its location.

55. Text corrected; response adequate.

56, 57. The artificial-appearing configuration of the Interface Dewatered Zone hardly lends confidence to the description in Section 3.8.2.4, p. 3-44. With reference to that section, why is only the "eastern" edge of the IDZ defined as explained? Isn't the whole area so defined?

58. Weston says that the values used in calculating "estimated rates of ground water flow," Section 3.8.2.5, p. 3-44, are not believed to be arbitrary. When gradients are taken at selected points based on sketchy contours in water-bearing units known to be influenced by nearby pumping, and hydraulic conductivities and effective porosity values are assumed, these values might be considered arbitrary.

In making these velocity estimates, the following questions/concerns arise:

1) What is the basis for using effective porosity values of 0.35 for the fill, 0.25 for the sand and gravel, and 0.10 for the sandstone? Does the 0.35 value for the fill apply to both the highly compacted and less highly compacted fills?

For unconfined aquifers, the effective porosity is the same as the specific yield, or storativity. The relatively high values used for the fill and sand and gravel certainly imply that Weston regards both units as unconfined. Both values are higher than M&E has seen, based on pumping tests in Ohio. Lohman, in Prof. Paper 708 p. 8, M&E has seen, based on pumping tests in Ohio. Lohman, in Prof. Paper 708 p. 8, gives the common range for specific yield for unconfined aquifers as 0.1 to 0.3 with an average of about 0.2. It is our opinion, therefore, that both values for effective porosity used for the unconsolidated materials are too high, especially that for the fill.

2) How was the saturated thickness of 250 feet for the sandstone aquifer determined? The test holes on site, drilled by the Ohio Drilling Co. in 1984, show the Sharon Sandstone (with its numerous shale interbeds) to be about 130 feet thick. Moreover, water does not move through all sections of the sandstone with equal facility. For example, in the first test well (in which the sandstone was 99 feet thick, between 66 and 165 feet), the specific capacity of the section between 100 and 120 feet was 0.65 gal/min per foot of drawdown, and the specific capacity of the section between 120 and 140 feet was 5 gal/min-ft. The specific conductivity below 140 feet was "less than 0.04 gal/min-ft. (This information was supplied by Ohio Drilling Co.)

The hydraulic conductivity of the sandstone was determined by dividing the transmissivity by the saturated thickness. Because the transmissivity ranged from 12,000 to 68,000 gal/d-ft, based on the pumping test (see Table 3-6, p 3-29) the average value of 32,000, used by Weston, doesn't seem to mean much, especially as they used 250 feet for the saturated thickness.

Flow velocities presented in the report have very little relevance, even as order of magnitude "guesses."

59. Weston says the terminology has been clarified. For instance, on p. 4-1, paragraph 3, "layer one" (of a two-layer system) is defined as the "unconsolidated aquifer zone." Does this "zone" include everything above the bedrock, including the fill, or does it mean the sand and gravel aquifer only? In the original text, p. 4-1, same paragraph, it is stated that "layer one" consists of the "unconsolidated glacial deposit (sic)." On p. 3-28 (revised report) reference is made to "the bedrock and unconsolidated zones." We can conclude that the fill, if it is included at all, is considered part of the "unconsolidated zone," or layer one.

A further note relative to p. 3-28, fourth paragraph, "The extent of hydrologic connection between the bedrock and the unconsolidated zones was analyzed by comparing the total drawdown and recoveries (sic) in the respective wells." All that is given in the way of an "analysis" are Fig. 3-14 (p. 3-30) and Fig. 3-15 (p. 3-31) showing "total drawdown" and "total recovery," respectively. These drawings show that most wells were affected by pumping. In most wells drawdown exceeded "total" recovery but in other wells, for example R-1, W-10, and a few of the lagoon wells, recovery was more than drawdown. Weston presents the two figures with no explanation and ignoring these ambiguities makes the "analysis" insufficient.

As indicated earlier, Weston's response to Item 49 is that the terminology has been clarified. The EPA called attention to p. 3-36 (old report) where three zones are defined, including the fill, the unconsolidated glacial deposits, and the bedrock, and asked for clarification. In response, that same paragraph is reproduced, without change, in the new report (p. 3-37) except that hydrogeologic regime is now called hydrogeologic system.

Paragraph 3, section 3.8.2.1, p. 3-37, makes it clear that in the plant area (which after all is the area we are most concerned with) there are three layers (or zones?) to be considered, not two. It is obvious that in the model the fill and glacial deposits are included together as layer one.

60. Weston's response to the five important statements for which answers or explanations are requested is completely inadequate except for the minor point raised in Item 1. Consider the points raised by EPA, beginning with Item 2:

2) The transmissivity map of the bedrock aquifer, Fig. 4-3, shows an increase in transmissivity eastward where the aquifer becomes progressively thinner. Weston says only that this is the way the model was set up. We can infer this, but why?

Additionally, the transmissivity contours in the plant areas show the simulated transmissivity to range between 6,500 and 32,000 gal/d-ft. The pumping test showed the transmissivity to range from 12,000 to 66,000 gal/d-ft. Why did Weston bother with the test in the first place?

3) EPA wants to know what hydraulic conductivity values were applied to the outwash deposits in the vicinity of the river. The questions is not answered; only that the values used provided simulated drawdowns that closely matched the observed drawdowns. Where did the "observed drawdowns" come from - does Weston know the drawdown in the OWS wells 1,2, and 3 under pumping conditions?

4) EPA points out that the contours on Fig. 4-1 (layer 1) in the vicinity of the plant did not resemble those in Fig. 3-20. The match is better now that Fig. 3-20 has been substantially revised; however, Weston's response ignores this fact and refers instead to well I-8, which they say they had previously ignored but will use for recalibration. We don't understand their response.

Relative to Figs. 3-20 and 4-1, note how much bigger the dewatered zone is in 3-20 than in 4-1. In Fig. 4-1 the dewatered zone extends beneath the lagoon. How is this to be explained in light of the contours and data shown in Fig. 3-19, the contour map for the lagoon wells?

5) EPA wants to know why Fig. 4-2 shows a cone of depression in the bedrock at OWS well 1. Weston says it's because the "calibrated maps" show that the bedrock and unconsolidated layers are hydraulically connected. No doubt they are, but M&E believes this "appears to be" an example of using the computer to "generate" field data. Figs. 4-1 and 4-2 show that the size and extent of the cone in the bedrock are comparable to the size and extent of the cone in the unconsolidated deposits. Because we are not informed what hydraulic values were used for each medium, and because no field data are available, it is hard to judge how reasonable these maps are.

General Comments Section 4.4, Page 4-2

1. Weston states that it is "crucial" to incorporate into the model the transmissivity values determined from the aquifer test of the bedrock aquifer. We have already pointed out in our comments relative to Item 60 that the values used in Fig. 4-3 are not the same as the values determined from the test.

2. On p. 4-5, paragraph 2, the modelers say they used a conductivity value for till of 1.7 E-6 ft/sec and a value for glacial outwash of 8.0 E-4 ft/sec (using computer notation). However, on the conductivity map Fig. 4-4, for layer one (the unconsolidated deposits) the values range from 2.0 E-4 to 6.0 E-4 ft/sec. Translated into common terms, Weston says they used conductivity values ranging from 1 to 517 gal/d-ft^2; the map shows a range of 129 to 388 gal/d-ft^2. It seems evident to M&E that the guy who made the model hadn't read the report.

61. Response adequate.

62. Weston's defense of their top of rock map, based on "the general shape" of the 825-foot contour, is totally inadequate. M&E pointed out that buried valleys in Ohio typically have steep sides and a fairly flat floor.

What we should have added is the fact that a top of rock map made by the Ohio Division of Geological Survey of the same area, based on regional as well as local data, is exactly as we described it, a wide valley with steep sides whose lowest contour is the 800-foot contour which lies close to the valley walls on each side. Weston's top of rock map shows a buried valley sloping uniformly to the northeast, continuing beneath the Tuscarawas River, and at least 1500 feet beyond the river into an area of shallow bedrock (ground surface ±950-1000 feet) where the map says the bedrock elevation is 625 feet and still descending.

The most inadequate thing about Weston's top of rock map Fig. 4-5 is that they show the top of rock elevation in the vicinity of Ohio Water Service wells 1,2, and 3 to range between about 720 and 730 feet. This is well below the base of the sandstone aquifer (Sharon 55), the base of which is about 770-feet elevation on site as shown by the test holes drilled in 1984 by the Ohio Drilling Co. The southeast regional dip won't alter this; in fact, because the OWS wells are slightly up dip from the Ekco plant, the "discrepancy" is made even worse.

63. M&E thinks the semi-perched water zone in the vicinity of the lagoon could have been incorporated into the model. Weston says they tried to do this but couldn't. They say the primary purpose of the model was to "evaluate various pumping scenarios on off-site groundwater flow," implying that the area around the lagoon, the source of the contamination, isn't that important.

However, on p. 4-1, first paragraph, Weston says the purpose of the modeling was, in part, "to evaluate present remediation activities..." No mention is made of "off-site groundwater flow." If a model is deemed necessary, why wouldn't greater emphasis be given to the effects of the present pump and treat system on ground-water levels at the source of contamination?

64. Instead of complete titles, Weston has inserted a reference to "figures 4-6 through 4-15" (p. 4-5, next to last paragraph). There were five simulations and two figures for each one; hence there are 10 figures.

M&E has questions relative to the simulation maps (Figs. 4-5 through 4-15):

1. In all simulations the pumping rates used for the three OWS wells are 2800, 1260, and 350 gal/min. Data that M&E developed independently indicate pumping rates for these wells of 2800, 1300, and 600 gal/min. Granted, the overall difference is not that important, but does Weston have more up to date information?

   Also, in all five simulations of layer one the water level elevation in the center of the cone around the OWS wells is about 896 feet (M&E knows it may not be practical to show the absolute lowest contour; however the center of the cone is not at the center well, where "pumpage" is greatest, but slightly north of that well). The elevation of the "undisturbed" water level, outside the cone, is about 912 feet (see Figure 4-6 near the bottom of the map). Therefore, the maximum drawdown at the center of the cone is about 16 feet. For a combined pumping rate of 4,410 gal/min (6.4 mgd) this seems to M&E modest indeed; even counting on river infiltration, the effects of which are shown on none of the simulation maps. Remember, this is in a sand and gravel aquifer to which has been assigned a conductivity value of 8.0 E-4 ft/sec. (p. 4-5). This translates to a hydraulic conductivity of about 500 gal/d-ft^2 in the area of the OWS wells.

2. In all simulation maps of layer 1 (Figures 4-6, 4-8, 4-10, 4-12, and 4-14) the "dewatered zone" is shown as it had been depicted originally, not as subsequently revised (see revised Figure 3-20, p. 3-41). Consequently, none of the simulated contours for layer 1 are carried into the plant and lagoon area; they all stop at the unrevised boundary of the "dewatered zone."

3. What the simulations show is that to pump wells W-1 and W-2 will create a cone (cones) of depression beneath the Ekco plant and the closed lagoon. Pumping will result in a ground-water divide in the unconsolidated deposits between the plant and the three OWS wells, but the maps give no detail of the effects in the unconsolidated deposits in the plant area. This picture is borne out by revised map, Figure 3-20, the data for which obviates the need for a model, as we have previously indicated.

4. None of the simulations for layer 2 (the bedrock) were programmed for a pumping rate of 322 gal/min from W-10, the only well pumped during the test of December,

1988 (see p. 3-28). Such a simulation would have allowed a direct comparison between the computer map and the field data.

65. Response adequate.

66. Weston is correct in that the outwash and bedrock aquifers are hydraulically connected. The problem of the magnitude of the effects on water levels in the sandstone caused by pumping a well screened in the outwash isn't going to be solved by use of a simple two-layer, steady state model.

67. Weston is wrong; the limits of the dewatered zone have not been changed on Figures 4-10 and 4-12 (nor for that matter on any of the simulation maps), nor have the figures been changed. Well I-7 is not shown on these maps; one has to look on other maps (for example figure 3-12, Page 3-24) to find out where I-7 is.

68. Response adequate.

FIGURES

1. Figure 1-2 should identify fence in legend.

2. Figure 1-3 is now Figure 1-5, Page 1-21.

3. Figure 1-5 is now Figure 1-7, Page 1-24.

4. Figure 1-6 is now Figure 1-8, Page 1-25.

5. Table 3-6 is now on Page 3-29. Figure 3-13 is now Figure 3-14, Page 3-30.

   M&E continues to disagree with Weston about the choice of 'heterogeneity" or "anisortropic" to characterize the aquifer at Ekco. Below is how these terms are defined in USGS Water-Supply Paper 1988*, Page 8-9:

   > "Homogeneity is synonymous with uniformity. A material is homogeneous if it's hydrologic properties are identical everywhere.

"Isotrophy is that condition in which all significant properties are independent of direction."

* "Definitions of selected ground-water terms," by Lohman and others.

If Weston can show how a range in transmissivity of 12,000 to 68,000 gal/d-ft in five observation wells can be interpreted as representative of an istotropic aquifer in which "all significant properties are independent of direction" then we are eager to be educated. The argument in this instance is splitting hairs; it is obvious that the aquifer is both heterogeneous and anistotropic.

6. Figure 3-2 is now Figure 3-3, Page 6; Figure 3-4 is now Figure 3-5, Page 3-16; Figure 3-5 is now Figure 3-6, Page 3-17; Figure 3-6 is now Figure 3-7, Page 3-18; Figure 3-9 is now Figure 3-10, Page 3-21; Figure 3-10 is now Figure 3-11, page 3-22. All figures have been revised. Weston should have identified these figures, and others, by their new numbers.

7. Figure 3-15 (fill isopack map) has been replaced with Table 3-7 (Thicknesses of fill materials), page 3-33.

   Weston could, for convenience, have told us the number of the new table.

8. Response adequate.

9. Response adequate.

10. Response adequate.

11. Response adequate.

12. Response adequate.

13. Boring I-6 still does not show the 7 inches of shale found at the bottom of the boring.

14. Response adequate.

15. M&E notes that although the bedrock contour map, Figure 3-18, Page 3-36 was revised, the revision was not extended to Figure 4-5, Page 4-8 (Ekco model bedrock top, layer 2). Note the position of the 925 foot contour on both maps.

16, 17. Figure 3-19, Page 3-40, (ground water contour map for lagoon wells) has indeed been revised, but not in line with EPA's comment. The revision amounted only to the chopping off of the contours west of the railroad.

18. Response adequate.

19, 20. M&E cannot locate Tables C-1 and D-1. Weston's response to Item 20 is not appropriate.

21. Weston should provide a more adequate response to our statement relative to vertical leakage during the aquifer test. How does it affect the model?

Comments relative to Table 3-7 (thickness of fill) Page 3-33.

Well	Fill Material Thickness (ft)	
	Weston	M&E
I-2	0-5	5
I-3	5	7
I-4	0-5	2
I-5	17	17
I-6	7	12
I-7	7	7
I-8	0-3.5	?
L-1	17	27
L-2	22	23
L-3	0-3.5	0
L-4	0-3	0
L-5	0-7	5?
P-3	0-3.5	0?
P-4	0-3	15?
P-5	22	22

What does Weston mean when they show fill thickness as 0-5, for example; how can there be a range in thickness in a single well?

MAR 0 2 1990

5HR-12

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Gerald Myers
Metcalf and Eddy
6840 Busch Boulevard
Suite 200
Columbus, Ohio 43229

Dear Mr. Myers:

Enclosed please find the revised Groundwater Quality Assessment Report along with the United States Environmental Protection Agency's (U.S. EPA) deficiency letter and EKCO's response.

The review of this report is due to the U.S. EPA within fifteen (15) days of receipt.

If you should have any questions please contact me at (312) 886-4439.

Sincerely yours,

Sally Averill
Ohio/Minnesota Technical Enforcement Section

	TYP.	AUTH	IL/IN TECH. ENF. SEC.	MI/WI TECH. ENF. SEC.	OH/MN TECH. ENF. SEC.	IL/MI/WI ENF. PROG. SECTION	IN/MN/OH ENF. PROG. SECTION	RCRA ENF. BR. CHIEF	O.R. A.D.D.	WMD DIR
INIT. DATE	SHB 3/2/90	SA 3/2/90	[illegible]							

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT HAZARDOUS WASTE SITES

TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. 483

TECHNICAL DOCUMENT REVIEW:

GROUND WATER QUALITY ASSESSMENT REPORT FOR EKCO HOUSEWARES, INC.

EPA REGION V

JACOBS ENGINEERING GROUP, INC.
PROJECT NO. 05-B483-00

WORK ASSIGNMENT PERFORMED BY:

METCALF & EDDY, INC.
6480 BUSCH BOULEVARD, SUITE 200
COLUMBUS, OHIO 43229

AUGUST 24, 1989

JACOBS ENGINEERING GROUP INC.
ENVIRONMENTAL SYSTEMS DIVISION
222 S. RIVERSIDE PLAZA - SUITE 1870 CHICAGO, ILLINOIS 60606 (312) 648-0002 FAX (312) 648-0551

August 28, 1989

Ms. Sally Averill
TES IV Primary Contact
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

**Re: Contract No. 68-01-7351
Work Assignment No. 483
Project No. 05-B483-00
Ekco Housewares
Massillon, Ohio
Technical Review of Documents
RCRA, Region V**

Dear Ms. Averill:

Please find submitted herewith two (2) copies of Review Comments on the RFI/CMS Work Plan and Monthly Groundwater Sampling Results for the Ekco Housewares facility in Massillon, Ohio.

If you have any questions or need clarification on any of these comments, please feel free to call Gerald Myers of M&E at (614)436-5550, or myself at (312)648-0002.

Sincerely,

Michael J. Strimbu

Michael J. Strimbu
Acting Regional Manager

Enclosures(2)

cc: F. Norling, EPA RPO

TABLE OF CONTENTS

1.0 INTRODUCTION

U.S. EPA entered into a Consent Agreement with Ekco Housewares, Inc. under Section 3008(h) of RCRA in 1987. This action requires Ekco to conduct a RCRA Facility Investigation, Corrective Measures Study, and Corrective Measures Implementation (RFI/CMS/CMI) at their Massillon, Ohio facility. A corrective action alternative will be selected by U.S. EPA and implemented by Ekco at the completion of the RFI/CMS.

U.S. EPA has requested that the TES Contractor represent U.S. EPA and provide assistance in monitoring and inspecting any RFI/CMS/CMI work performed on-site, provide professional technical support personnel to review the Corrective Action Plan, draft and final RFI, CMS, CMI reports, and conduct an independent, preliminary hydrogeologic assessment of the Massillon, Ohio area.

This document presents the TES contractor's review comments on the June, 1989 RFI/CMS Work Plan and Monthly Ground Water Sampling Results presented by Ekco Houseware's contractor, Weston, Inc. Metcalf & Eddy employees Steve Hullett, Geologist; Stan Norris, Senior Geologist and Jeff Wilson, Engineer conducted the technical review.

2.0 GENERAL DESCRIPTION

The Ekco Housewares, Ohio Plant, Massillon Division, is located at 359 State Avenue Extension N.W., in the eastern part of Massillon, Ohio. The facility is due north of the juncture of the Penn Central and Baltimore and Ohio Railroads, south of Newman Creek, and west of the Tuscarawas River.

The reasons for concern in this area are that hazardous chlorinated organic compounds have been detected in groundwater which provides the Massillon municipal water supply. The Massillon municipal wells are owned and operated, under contract, by the Ohio Water Service Co. One well has already been abandoned because of contamination by the organic solvents and their degradation products.

The suspected source of contamination is the industrial and residential area about two-thirds of a mile west of the Tuscarawas River in which Ekco Housewares, Inc., is located. Ekco is known to have used the contaminants found in the groundwater, and is suspected of having released them to the environment.

The Ekco Housewares has been in operation since at least 1945, and operated an industrial waste water treatment lagoon until 1985. The lagoon was operated under RCRA interim status since 1980. The plant also has an Ohio NPDES permit to discharge industrial waste water to Newman Creek and the Tuscawarwas River.

The plant discharged approximately 200,000 gpd of contaminated industrial process wastewater to the lagoon. Because there is no record of a surface discharge from the lagoon, it is surmised that contaminated waste water from the lagoon has leaked into the groundwater below the facility.

3.0 SPECIFIC COMMENTS ON EKCO HOUSEWARES RFI/CMS WORK PLAN; JUNE 1989

Section 1

1. Section 1.1, Page 1-1, Paragraph 2, Line 10.

   Newman Creek borders the Ekco property on the north, not the northwest.

2. Page 1-1, Paragraph 2, Line 12.

   Weston stated locations of the railroads are reversed. See map Figure 1-1, Page 1-2. Also, with respect to Figure 1-1, the quarry west of the plant is a sandstone quarry, not a sand and gravel pit.

3. Section 1.2.2, Page 1-4, Paragraph 2, Line 7.

   M&E questions this statement that the "Ground Water Reclamation Program" was started in 1985. According to Table A-1 in Appendix A it was 1986.

4. Page 1-4, Paragraph 2, Line 9.

   M&E questions what is meant by "incoming production well water"?

5. Page 1-4, Paragraph 2, Line 14.

   Westons title of the report is wrong; the report is called Ground Water quality assessment report, not an "assurance plan."

6. Table 1-1, Page 1-5.

   M&E questions if all plating operations "ceased in 1978," they must have been restarted sometime between 1978 and 1987. They were going on evidently in 1987.

7. Section 1.3, Page 1-6, Paragraph 3, Line 4.

M&E wonders how Weston can "describe" certain activities in sufficient detail to "complete all tasks"? The report suggests that there is a need to protect human health and the environment, but only if it is "cost effective."

Section 2

8. Section 2.1.1, Page 2-1, Paragraph 3, Line 5.

M&E would like to know the meaning of "occasional thin limestone units?"

9. Figure 2-2, Page 2-5.

Not all of the referenced legend is clearly seen on the map.

10. Figure 2-3, Page 2-6.

M&E questions why I-2 does not show the same section in both Figure 2-3 and Figure 2-4. Weston shows two different logs on the respective figures.

11. Figure 2-4, Page 2-7.

M&E questions the thickness of fill material at locations I-2 and I-5. With reference to Figure 2-2, Page 2-5, I-2 fill is 20 feet and I-5 is 8 to 10 feet thick. On the figures the logs show the same fill thickness.

12. Figure 2-4, Page 2-7.

M&E can not find in the legend a description of the material shown in I-6 between the 900-920 foot level.

13. Page 2-11, Paragraph 3, Line 3.

M&E would like to know the meaning of "occasional limestone."

14. General Comment Section 2.

M&E finds the discussion of the geology and hydrogeology is essentially a repeat of the material, including figures, in the Ground Water Quality Assessment report which has already been reviewed separately.

Section 3

15. Section 3.1.2, page 3-1, Paragraph 4, Line 3.

Weston states that most VOC's are in the vicinity of the closed lagoon at depths less than 20 feet. In the Ground Water Quality Assessment Report, Page 4-5, it states as follows: "...the shallow zone near the lagoon consists of a high percentage of fill, with some silt and clay, which significantly affects water levels. Due to the lack of adequate shallow well control away from the lagoon area, it was not possible to incorporate the shallow fill zone into the model..." Thus, the very area where prediction is most needed cannot be modeled.

16. Section 3.2.1, Page 3-3, Paragraph 2, Line 2.

Weston states that soils could migrate through surface water runoff. Could this be by soil erosion?

17. Section 3.2.4, Page 3-4, Paragraph 1.

M&E finds this paragraph confusing.

18. Section 3.4.1.1, Page 3-5, Paragraph 4, Line 4.

M&E would like to know if there is reason to explain that a treatment facility at EKCO cannot be located within 200 feet of a recent fault or on a flood plain?

19. Figure 3-1, Page 3-9.

M&E questions the location of the inactive and active Hazardous Waste Storage Areas, as well as the location of the inactive incinerator. In prior documentation they are located differently.

Section 4

20. Figure 4-1, page 4-2.

M&E would like to know why there is no map scale shown? Of the seven proposed monitor well locations, 3 are in the vicinity of Ohio Water Service wells 1, 2, and 3. They are indicated as interface wells which means they will be deeper than OWS-1, 2, and 3 but probably not much deeper. M&E doubts that the chemical data to be gained from the three new wells will be any different from data already available from OWS-1, 2, and 3. Two locations (11 and 12) are in the vicinity of well P-4. P-4 should have been developed as a monitor well in the first place, as should P-3.

21. Section 4.1.3.1, Page 4-8, Paragraph 3.

Weston admits that the model (MODFLOW) is in need of "refinement." They will use the hydraulic information derived from the new monitor wells in the refinement process, including transmissivity and storativity. M&E questions how Weston plans to determine these factors; from slug tests? If so, Weston should read the paper by Cooper et al in Water Resources Research V3, No. 1 entitled, "Response of a Finite Diameter Well to an Instantaneous Charge of Water." The authors point out that, "a determination of S by this method has questionable reliability." They also quote from Ferris et al, 1962, in Theory of Aquifer Tests (USGS Water-Supply Paper 1536-E), as follows: "...the duration of a 'slug' test is very short, hence the estimated transmissibility determined from the test will be representative only of the water-bearing material close to the well. Serious errors will be introduced unless the...well is fully developed and completely penetrates the aquifer." Slug tests of monitoring wells, where the screens are surrounded by an artificial envelope of graded gravel, gives a value for...what?

M&E asks why refine an inadequate model? Weston surely can't get enough data from the new monitor wells to help much, when only one of seven proposed locations are on site.

22. <u>Section 4.1.3.2, Page 4-9, Paragraph 2, Line 2.</u>

M&E questions if the model is inferior, needs refinement, and cannot incorporate the area of principle contamination; why does Weston need a solute transport model which, M&E believes will suffer from the same inadequacies?

23. <u>Figure A-1, Page A-9.</u>

M&E believes that the outfall is on the south side of Newman Creek instead of on the north side as shown.

SPECIFIC COMMENTS ON MONTHLY GROUND WATER SAMPLING RESULTS

1. M&E has some concern over sampling data from Ohio Water Service Wells #1 and #3 analyzed on May 12, 1989. They both have concentrations of 2 ppb Vinyl Chloride detected. The maximum MCL allowed by U.S. EPA Drinking Water Standards is 2 ppb.

M&E®

Metcalf & Eddy

6480 BUSCH BOULEVARD
SUITE 200
COLUMBUS, OHIO 43229
TELEPHONE (614) 436-5550
FAX: (614) 436-5872

August 24, 1989

Ms. Sally Averill
RCRA Enforcement
U.S. EPA - Region V
230 S. Dearborn Street
Chicago, Illinois 60604

RE: Review Comments, RFI/CMS Work Plan and Monthly Ground Water Sampling Results - EKCO Housewares, Massillon, Ohio. Contract #68-01-7351 Work Assignment No. 483.

Dear Ms. Averill:

Enclosed please find review comments regarding the above referenced documents.

If you have any questions or comments, please feel free to contact me at (614) 436-5550.

Sincerely,

Michael [illegible] for

Gerald R. Myers
Senior Project Manager

cc: S. Norris
J. Strayton
T. Struttmann
M. Strimbu
S. Hulett
J. Wilson
J-File

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT HAZARDOUS WASTE SITES

TES IV

CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. 483

TECHNICAL DOCUMENT REVIEW:

RFI/CMS WORK PLAN AND MONTHLY GROUND WATER SAMPLING RESULTS FOR EKCO HOUSEWARES, INC.

EPA REGION V

JACOBS ENGINEERING GROUP, INC.
PROJECT NO. 05-B483-00

WORK ASSIGNMENT PERFORMED BY:

METCALF & EDDY, INC.
6480 BUSCH BOULEVARD, SUITE 200
COLUMBUS, OHIO 43229

AUGUST 24, 1989

TABLE OF CONTENTS

1.0 INTRODUCTION

U.S. EPA has entered into a Consent Agreement with Ekco Housewares, Inc. under Section 3008(h) of RCRA in 1987. This action requires Ekco to conduct a RCRA Facility Investigation, Corrective Measures Study, and Corrective Measures Implementation (RFI/CMS/CMI) at their Massillon, Ohio facility. A corrective action alternative will be selected by U.S. EPA and implemented by Ekco at the completion of the RFI/CMS.

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The plant discharged approximately 200,000 gpd of contaminated industrial process wastewater to the lagoon. Because there is no record of a surface discharge from the lagoon, it is surmised that contaminated waste water from the lagoon has leaked into the groundwater below the facility.

3.0 SPECIFIC COMMENTS ON EKCO HOUSEWARES GWQAR; MAY 1989

1. Page ii, Paragraph 3, Line 7.

This section should be titled (Soil Boring Inorganic Results - Cd, Cr, Pb) as on Page 3-9.

2. Page iii, Paragraph 3, Line 5.

Appendix-C should read (Protocols For Installation) as it is actually titled on the cover page of Appendix C..

Section 1

3. Section 1.2, Page 1-2, Paragraph 2, Line 2.

Include the address (3rd street N.W.).

4. Section 1.2, Page 1-2, Paragraph 1, Line 4.

Weston has stated, "Land use to the northwest is more rural with a larger proportion of open space." "More rural" than what; and what about the land southwest of the site?

5. Page 1-2, Paragraph 3, Line 6.

Of all the Ekco reports reviewed previously, this is the first reference we've seen to a "relatively large, inactive municipal landfill." Was it just recently discovered? Please describe and explain.

6. Section 1.3, Page 1-4, Paragraph 1, Line 2.

In the mid sixties EKCO stopped using TCE and then reinstated it's use in the 1980's. Was 1,1,1,-TCA used in the interim or were other solvent based cleaners used?

7. Page 1-4, Paragraph 2, Line 3.

Metcalf & Eddy questions why the 1969 NPDES permit number and a copy of it are not provided. Also, why isn't a copy of NPDES permit C-3094BD provided?

8. Page 1-4, Paragraph 7, Line 1.

The surface impoundment waste stream was diverted in December 1985. Where was it diverted? When the lagoon was taken out of service. Was it drained? Where to? Or was the waste water allowed to seep into the ground?

9. Section 1.4, Page 1-6, Paragraph 4, Line 5.

Weston says soil boring results indicated apparently elevated levels of cadmium, chromium and lead. Were the levels "apparently" elevated, or were they elevated?

10. Page 1-7, Paragraph 3, Line 2.

Metcalf & Eddy questions whether it was "February 1988" or December 1987, that the interim measures report was presented.

11. General Comment.

Metcalf & Eddy would like to see maps of previous investigation activities.

12. Section 1.5.1, Page 1-7, Paragraph 5, Line 7.

An improved description of the geology is necessary. The author states that the glacial drift ranges in thickness from less than 25 to about 100 feet, but follows with a statement that it can exceed 500 feet in "areas of buried valleys." Here are the facts: In four of the wells drilled on site (R1 thru R4) the depth to bedrock ranged from 32 to 92 feet. The unconsolidated deposits do not exceed about 150 feet in thickness in the Tuscarawas Valley as indicated by top of rock maps of the Ohio Division of Geological Survey. The author evidently is referring to a general statement in a state report covering all of northeast Ohio when he says the deposits "can exceed 500 feet in thickness."

13. Page 1-8, Paragraph 2, Line 2.

Why are Devonian rocks included as part of this statement? Only Pennsylvanian and Mississippian rocks are exposed at the surface or beneath the glacial deposits.

14. Page 1-8, Paragraph 2, Line 5.

Metcalf & Eddy would like to know what is "occasional thin limestone units." When does this occur?

15. Page 1-8, Paragraph 2, Line 6.

With respect to the consolidated rocks, the description is taken from Cross and Hedges (not Cross, as stated) from a report on Ohio stream flow. The statement applies to the Muskingum River basin, which includes all or parts of at least 20 counties (see Plate 18 of the reference cited).

16. Section 1.5.2, Page 1-8, Paragraph 3, Line 9 and 10.

The author quotes Schmidt (1962) rather than Walker (1979), who updated Schmidts' work. Further, in Table 1-1, Page 1-10, he applies Schmidts' description relative to the Middle Tuscarawas Basin to the entire Tuscarawas Basin.

17. Section 1.5.3.1., Page 1-13, Paragraph 1, Line 2.

Weston should mention why well OWS-4 was abandoned.

18. Section 1.5.3.2, Page 1-13, Paragraph 4, Line 1.

States that pump and treat system was started in February 1986; on Page. 1-6, Paragraph 3, it says February 1985.

19. Page 1-16, Paragraph 1, Line 3.

It is misleading to characterize the section in well W-1 as "a series of interbedded sandstones and shales." The section is better described as sandstone with a few shale beds. In the log of R-1 for example, the Sharon section consists of a total of 109 feet of sandstone and 12 feet of shale, the shale occurring in 4 scattered "breaks," the thickest being 4 feet.

Section 2

20. Section 2.2, Page 2-3, Paragraph 3, Line 1.

Metcalf & Eddy questions how Weston plans to evaluate groundwater quality with piezometers 3, 4, and 5.

21. Page 2-3, Paragraph 4, Line 3.

Metcalf & Eddy questions why these wells are installed so close to the source.

22. Section 2.3, Page 2-4, Paragraph 1, Line 4.

Metcalf & Eddy would like to know what Weston considers "major physical structures."

23. Page 2-4, Paragraph 1, Line 5.

Metcalf & Eddy would like to know where the USGS bench mark is located.

24. Page 2-4, Paragraph 2, Line 3.

Buckeye, Inc. provided a base map with coordinate grid system to Weston, why didn't Weston supply it in this report?

25. Section 2.6.2, Page 2-5, Paragraph 2, Line 5.

Metcalf & Eddy would like to know whether the sample was collected "from" or "at" the plant discharge?

Section 3

26. Section 3.3, Page 3-2, Line 4.

How major were these structures and what minor structures were left unsurveyed?

27. Section 3.4, Page 3-2, Paragraph 5, Line 3.

Weston says there is a possible source of TCE and 1,1,1,-TCA in this area, a solvent tank and a pipeline. Why wasn't this tank and pipeline shown on a map? Why doesn't Weston supply a point source map?

28. Page 3-2, Paragraph 6, Line 4.

Metcalf & Eddy questions what Weston is talking about, as well as where are sampling points SG-23A, SGW-10A and SG-27B? Figure 3-2 is difficult to read.

29. Page 3-6, Paragraph 1, Line 1.

Why does Weston expect these impact areas to be limited when they admittedly don't have sufficient data to substantiate this view. Metcalf & Eddy believes the study area should be expanded.

30. Page 3-6, Paragraph 2, Line 2.

Metcalf & Eddy questions why Weston references a point source but fails to supply a point source map.

31. Page 3-6, Paragraph 2, Line 4.

Metcalf agrees with Weston that further investigation may be warranted to define the extent of contamination in the tank farm area.

32. Page 3-6, Paragraph 3, Line 2.

In reference to the "relatively minor soil VOC contamination," couldn't this also be explained by contaminate migration?

33. Section 3.5.1, Page 3-6, Paragraph 5, Line 5.

Once again Weston references a point source with no point source map.

34. Section 3.5.2, Page 3-9, Paragraph 3.

What are these averages and do they really tell us anything?

35. Page 3-9 and 3-10, Paragraph 4 and 5?

What good is all this discussion of background levels without some data on off-site-background levels.

36. Section 3.5.3, Page 3-10, Paragraph 4, Line 6.

How often are concentrations of copper, nickle, and zinc above Ohio Farm Soil limits?

37. Section 3.6.1.1, Page 3-10, Paragraph 5, Line 2.

Metcalf & Eddy questions Weston groundwater sampling results in Figure 3-3. Figure 3-3 is a soil boring and soil gas sampling location map.

38. Page 3-14, Paragraph 5, Line 3.

Metcalf & Eddy questions the casual dismissal of "relatively minor amounts of .96 ppb of TCE and 3.8 ppb of 1,1,-DCA" in well I-8.

39. Page 3-14, Paragraph 5, Line 4.

With high BTXE compound concentrations, one would immediately look for leaking fuel sources. Once again, no point source map.

40. Section 3.6.1.2, Page 3-22, Paragraph 4, Line 1.

What is the iron concentration of off-site wells and soils? Without knowing this, how can Weston make statements about the natural conditions on-site?

41. Section 3.6.2.1, Page 3-22, Paragraph 6, Line 2.

Metcalf & Eddy counts only three compounds in this sentence.

42. Page 3-22, Paragraph 6, Line 3.

Weston says that the presence of methylene chloride in samples SW-1, SW-4 and SW-5 was probably a result of laboratory procedures. Why not check the lab blanks and remove all doubt?

43. Page 3-24, Paragraph 1, Line 7.

Is Weston saying EKCO's discharge pipe is leaking?

44. Section 3.6.2.3, Page 3-24.

Using the measurements in this section, the discharge at the upstream station was 14.87 cubic feet per second. 1200 feet downstream, the discharge was 25.05 cubic feet per second. This is a discharge increase of 10.18 cubic feet per second, or an increase in flow of approximately 4570 gallons per minute. Although Ekco's discharge pipe is above the downstream station, M&E questions the accuracy of these measurements.

45. Section 3.6.3.1, Page 3-25, Paragraph 4, Line 1.

Once again Weston explains the presence of contaminates in stream samples as the result of laboratory procedures. Why not check lab blanks?

46. Section 3.7, Page 3-27, Paragraph 3.

A storativity of 0.0001 (in R-3) is that of a confined aquifer (USGS Prof. Paper 708, Page 8).

The range in T and S, 12,000-68,000 gal/d-ft, and 0.0001-0.002, indicate anisotropic conditions.

47. Page 3-27, Paragraph 3, Line 5.

Metcalf & Eddy believes that Weston should reference the storativity values for confined and unconfined aquifers.

48. Page 3-27, Paragraph 4.

Metcalf & Eddy finds the 4th paragraph puzzling. The fact that drawdown occurred in all 5 bedrock wells when W-10, also in bedrock, was pumped is not surprising.

49. Page 3-27, Paragraph 5 and 6.

The author implies that the spread of the cone is related to the pumping rate; it depends chiefly on T and S and the time of pumping. The pumping rate helps control the spread of the cone where there is a strong regional gradient.

50. Page 3-27, Paragraph 5, Line 2.

Metcalf & Eddy will agree that these drawdown values indicate a real connection between bedrock and interface layers, but we question if this can be considered minor.

51. Page 3-27, Paragraph 6, Line 6.

Metcalf & Eddy agrees, it is very possible that insufficient time elapsed for influence to be observed in shallow L, D, and S wells.

52. Section 3.8.1.2, Page 3-31, Paragraph 4.

M&E doubts that Weston means "inconsistencies" in speaking of horizontal and vertical permeabilities. How about "differences"?

53. Page 3-31, Paragraph 5

If the bedrock crops out, we're no longer talking about "subcrop" are we?

54. Page 3-31, Paragraph 5, Line 5.

Metcalf & Eddy would like a definition of "a bedrock subcrop."

55. Section 3.8.1.3, Page 3-31 Paragraph 6, Line 3.

What is a "geologic high." Also, why is "slope and dip" used interchangeably when they mean different things?

56. Page 3-36, Paragraph 2.

Weston, "For the purpose of this report" has subdivided the EKCO site into three zones. Each with unique hydraulic properties. What Weston appears to be losing site of is the interconnection between these zones. Weston isn't dealing with three confined aquifers.

57. Section 3.8.2.1, Page 3-36, Paragraph 2, Line 2

How can "regime," which the dictionary says means "a mode of rule or management," be divided into three zones?

58. Page 3-36, Paragraph 4, Line 5.

What does Weston mean by "normalize the pressure head"? By emphasizing the heterogeneity of the unconsolidate materials and the nonaccordance of water levels (because of semiperched saturated zones) the author is making it tough to explain his reasons, further on, for going to a computer simulation to show which way the ground water is moving in the plant area.

59. Page 3-37, Paragraph 3, Line 3

Weston says that bedrock is 130 feet deep "to the east at the site." Weston probably is referring to well I-6 which is off the site (see Figure 3-18).

60. Page 3-36, Paragraph 3, Line 7.

Weston states that both vertical and horizontal groundwater flow is being restricted due to the highly compacted fill material. In section 3.8.1.1, Page 3-31, Paragraph 2, Line 3, Weston says "at the surface the fill is very hard compacted material with low permeability. The fill is less compacted with depth." How can compaction be less with depth?

61. Section 3.8.2.2, Page 3-38, Paragraph 1, Line 4.

Metcalf & Eddy believes that five wells L-1 thru L-5 in such a small area leads to questionable evaluation of groundwater flow in the fill zone.

62. Page 3-38, Paragraph 2, Line 4.

Metcalf & Eddy agrees with Weston. At the time of measurement, Newman Creek was a losing stream. Metcalf & Eddy would also like to point out that it is not uncommon for a stream to be a losing stream at one point in time and be a gaining stream at another, varying with seasonal fluctuations of the water table.

63. Page 3-41 Paragraph 3, Line 8.

States that prior to 1988 pumping rates were less than those today and hence the area of influence was less. In the absence of a strong regional gradient the area of influence is independent of the pumping rate. It depends only on aquifer characteristics and time of pumping.

Thus:

$$r_o = \sqrt{\frac{.3Tt}{S}}$$

Where:

$r_o =$ distance to point of zero drawdown, feet.
$T =$ transmissivity in gal/d-ft.
$S =$ storativity.
$t =$ time in days, since pumping started.

64. Section 3.8.2.3, Page 3-41 & 3-42

Metcalf & Eddy believes this discussion of the ground-water flow system at EKCO is misleading. First, the author looks at the perched water table in the vicinity of the closed lagoon (lagoon wells) and discovers that the gradient is southeasterly towards the center of pumping. He then finds out that the "average gradient" increases as the distance to the pumped well becomes less. This fact is presented, with no explanation of its significance.

Attention is then focused on the interface zone (remember that three separate and hydraulically independent zones have been identified at EKCO despite all the evidence to the contrary) and the author demonstrates, by the strangest set of contours ever seen (Figure 3-20) that ground water in this intermediate zone is moving northwest. The author fails to explain why the water level in P-3 is 9 feet too high to fit his contours, or why he doesn't use data from P-4 and P-5, both of which are "interface" wells.

An inspection of the data points on Figure 3-20 shows that contours can be constructed that strongly indicate a cone of depression centering around the pumping wells. The water level elevation given for P-3 fits such a configuration and, perhaps so also would data from wells P-4 and P-5.

65. Section 3.8.2.4, Page 3-43, Paragraph 4.

Metcalf & Eddy would like to know how Weston estimated this dewatered zone.

66. Page 3-43 Paragraph 4.

The author tells us that in the vicinity of the plant (closer to the center of pumping) the "interface" zone has been dewatered. He shows, on Figure 3-20, the approximate area of this dewatered zone, even extending it west of the plant where he has no data and where, because of the shallow depth to bedrock, the "interface" zone, in the sense of its definition in the area east of the plant, cannot truly be said to exist.

The "interface" zone is hydraulically and intimately connected with the sandstone aquifer. The fact that a local semiperched water table occurs in the vicinity of the lagoon, and possibly elsewhere as well, doesn't change the fundamental character of the flow system at the EKCO site.

67. Section 3.8.2.5, Page 3-43, Paragraph 5-7.

To take gradients determined at selected points (essentially at random) in areas influenced by pumping, and using these arbitrary gradients among with estimates of hydraulic conductivity and porosity to determine rates of flow is questionable.

68. Section 4, Page 4-1, Paragraph 1-5.

Modeling was applied only to layers 1 and 2, the identification of which is left to the reader to figure out. Of course this is no big problem; it becomes obvious that layer 1 is the unconsolidated sediments and layer 2 is the sandstone. The reason we raise the point is that in the text we have somewhat different definitions of the "layers". On Page 3-27 we have three layers, called shallow, interface, and bedrock. On Page 3-36, three layers, called "zones", are identified, called "the fill, the unconsolidated glacial deposits, and the bedrock zones." (Why "unconsolidated" glacial deposits; are there "consolidated" glacial deposits?).

69. Section 4.3, Page 4-2, Paragraph 4.

The author says that the final calibration had an average head difference of 1.5 feet, except in P-4, where the difference was 2.99 feet. The question is, different from what, his contour map(s), or data points in wells measured 8/10/88, or something else?

Metcalf & Eddy looked at the transmissivity map, Figure 4-3 (see Page 4-6) for the bedrock aquifer and noted that the value goes up from west to east, in the direction in which the bedrock becomes thinner (see Figure 3-18). Metcalf & Eddy had thought the thicker the aquifer the larger the transmissivity.

Let's look next at the hydraulic conductivity values for layer 1, the unconsolidated sediments (see Figure 4-4, Page 4-7). The values shown, according to only three contours, range from 129 to 388 gal/d-ft^2 and obviously are meant to apply only to the sediments in the vicinity of the plant and to a narrow strip north of the plant. What values were used for the outwash sand and gravel near the river, which exceed those shown probably by a factor of ten? And why do we have a transmissivity map for layer 2 and a hydraulic conductivity map for layer 1?

Next consider the calibration maps, Figures 4-1 and 4-2 for layers 1 and 2, respectively (pages 4-3 and 4-4). Note first, that the contours on Figure 4-1, for layer 1, in the vicinity of the plant do not in the slightest resemble those in Figure 3-20 (Page 3-40) for the same area. They do, in the calibration, show the influence of pumping in the recovery wells, as we have repeatedly said. Metcalf & Eddy can't comment on the rest of the map because of missing data.

Now look at Figure 4-2, the calibration for layer 2, the sandstone. Why does the author show a cone of depression in the sandstone centering around well OWS1? One might infer that he has simply added contours from the layer 1 calibration in the center of the valley without telling us. We suspect so, even though the respective contours are not the same in all areas near the river, Page 4-5, Paragraph 2. What are "lower energy" sediments; and what do conductivity values of 1.7E-6ft/s, and 8.0E-4 ft/s, mean?

The author states that it was necessary to "input the bedrock top elevation..." and refers us to Figure 4-5. Metcalf & Eddy doubts that the bedrock surface resembles that shown in Figure 4-5. The buried valleys commonly have steep walls and a fairly flat floor, with their long axes parallel to the general course of the rivers. The buried valley as shown on Figure 4-5 slopes uniformly towards and well beyond the river, reading its lowest point, 650 feet, at two places on the map, in the northeast corner more than 1000 feet beyond the river, and in the southeast corner, beneath the river. Without belaboring the point further, it is highly unlikely that Figure 4-5 depicts accurately the bedrock floor of the Tuscarawas River Valley.

70. Page 4-5, Paragraph 4, Line 5.

The author says, "it was not possible to incorporate the shallow fill zone into the model..." M&E believes that a local semiperched water zone in the vicinity of the closed lagoon probably could be incorporated into the model. The author says he couldn't model the shallow zone because he had inadequate "shallow well control away from the lagoon." The fact is that "away from the lagoon", at least in the direction of the river, the semiperched zone doesn't exist and the water level in shallow wells represents the general water table in the unconsolidated sediments. Why couldn't it be modeled?

71. Section 4-5, Page 4-5, Paragraph 5.

It would have been helpful if the simulation maps had been given complete titles.

72. Page 4-5, Paragraph 6.

The author doesn't tell us the length of the shut off period. Do we assume the water levels have all returned to their original prepumping steady state? Anyway, there is no way to check out the magnitude of the water level rise the author predicts.

The main point here is that we are not told whether all pumping will stop. Won't the plant supply well continue to be pumped? The simulation maps Figure 4-6 and 4-7 indicate that no pumping at all will be going on.

73. Page 4-11, Paragraph 1.

States that at OWS-4 water levels would be lowered up to 24 feet in layer 1 and up to 10 feet in layer 2, the sandstone. Well OWS-4, 132 feet deep, is screened above the Sharon Sandstone. It is indeed puzzling how pumping in the sand and gravel can have such a significant effect on water levels in the sandstone. We'd like to hear the author's explanation, especially in light of Figure 3-20 which shows that contours for the "interface" zone have little to do with those in the sandstone. At least he's consistent in showing drawdown in the sandstone caused by pumping from the sand and gravel near the river. All simulations show drawdown in the sandstone in the vicinity of OWS wells 1, 2, and 3.

74. <u>Page 4-11, Paragraph 2 and 3.</u>

M&E won't comment on simulations 3 and 4, in which well I-7 is pumped, except to ask why the contours for layer 1 (Figures 4-10 and 4-12) are "chopped off" on the west side of the cone in the vicinity of I-7?

75. <u>Page 4-11, Paragraph 4.</u>

In simulation 5 Weston will double the pumping rate from wells W-1 and W-10 which will cause, among other things, an additional 10 feet of drawdown in the sandstone. Nowhere in this section are we told what these pumping rates are, so we have no way to judge whether the pumping rates can, in fact, be doubled.

76. <u>Section 5, Page 5-1.</u>

Metcalf & Eddy's comments on the 9 points are as follows:

1. Possibly true.
2. M&E agrees.
3. No comment.
4. The most important point. Why, if they had wanted this information didn't they construct P-3 and P-4 as monitor wells?
5. No comment.
6. No comment.
7. May be true.
8. Why not put a shallow recovery well in the lagoon area also. See Figures 3-4, 3-5, 3-6, 3-7, 3-8, and 3-10.
9. See response to point 4, above.

FIGURES GENERAL COMMENT

77. Metcalf & Eddy finds all figures to be cluttered and hard to read.

78. Figure 1-2, Page 1-5.

Metcalf & Eddy would like to know what the line emanating from the N-W corner of the Ekco Housewares plant, running along the railroad track and around the pond. What does this represent and why is it not in the legend?

79. Figure 1-3, Page 1-9.

Figure 1-3 could better be described as a geologic bedrock surface map and cross section of northeast Ohio. Surely, the author could have found a better geologic map than this one (for which no specific reference is given).

80. Figure 1-5, Page 1-14.

What is an "occasional residential well"?

81. Figure 1-6, Page 1-15.

If Figure 1-6 is a map of EKCO Facility Recovery Wells, why is the legend cluttered with all these well descriptions and why is piezometer P-4 on the map.

82. Table 3-6, Figure 3-13, Page 3-29.

It is evident from the distribution of drawdown at the end of the test that the aquifer is anisotropic. The drawdown values form a narrow, elongated cone oriented northwest-southeast (see attached drawing).

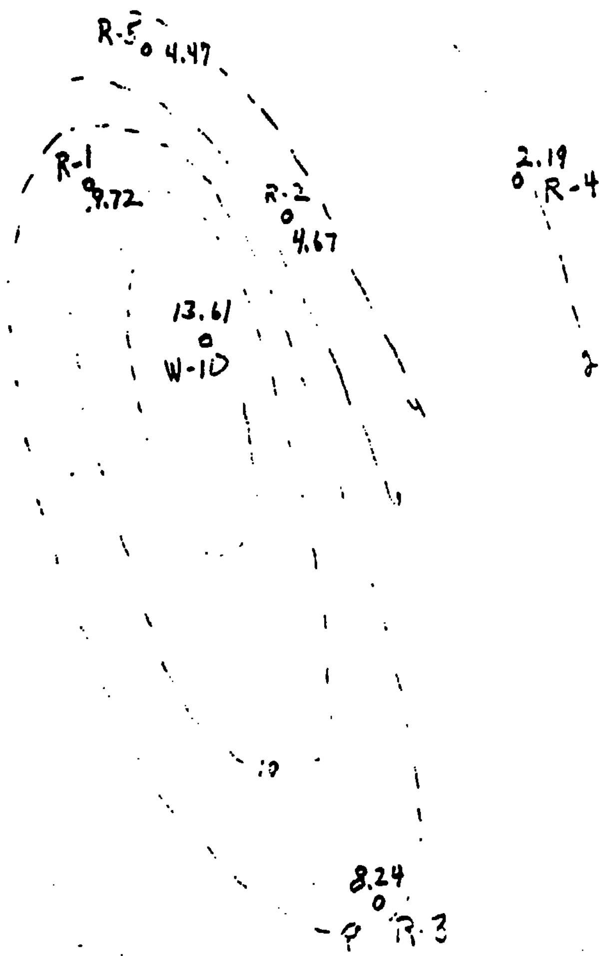

FIGURE 3-13 TOTAL DRAWDOWN (BEDROCK WELL)

83. Figure 3-15, Page 3-32.

It doesn't seem reasonable to Metcalf & Eddy to carry the isopach lines on Figure 3-15, Page 3-32, east of the railroad. Besides, in checking the well logs Metcalf & Eddy found discrepancies between the logs and fill thicknesses shown on the map. See below:

Well	Figure 3-15	Driller's Log
L-5	0 feet	±5 feet
P-5	±15 feet	22 feet
I-2	±20 feet	5 feet
I-5	8 feet	17 feet
I-6	± 8 feet	12 feet

We think a plain, uncluttered map showing fill thicknesses would have been more representative of conditions than a highly suspect isopach map.

84. Figure 3-16 and 3-17, Pages 3-33 and 3-34.

Please compare these two cross sections side by side. Figure 3-16 shows well I-2 as follows: approximately 11 feet of gravel and sand overlain by 5 feet of sandy clay, overlain by 20 feet of fill material. Figure 3-17 shows the same well, I-2 as follows: approximately 17 feet of sand and gravel overlain by 15 feet of fill material. The depth to bedrock is about 40 feet on Figure 3-16; 35 feet on Figure 3-17. What is the material in Figure 3-17, well I-6, from elevation 900 feet to approximately 913 feet?

85. Figure 3-16, P-5, Page 3-33.

Depth to bedrock 28 feet on section; 33 feet on log.

Figure 3-16, I-4, Page 3-33.

Depth to bedrock about 84 feet on section; 72.5 feet on log. The fill isopach map, Figure 3-15, shows between 0 and 10 feet of fill at I-4; on the log cinders are reported at about 12 feet. No fill is shown for I-4 on Figure 3-16.

Figure 3-16, I-8, Page 3-33.

Depth only about 77 feet on the cross sections; the log gives total depth (and top of sandstone) as 92 feet.

Figure 3-17, I-5, Page 3-34.

Depth to bedrock about 52 feet on section; 65 feet on log.

Figure 3-17, I-7, Page 3-34.

Depth to bedrock about 54 feet on section; 67 feet on log.

Figure 3-17, I-6, Page 3-34.

Depth to bedrock about 108 feet on section; log gives total depth of 132 feet, with 7 inches of shale at bottom. This probably represents a shale break in the Sharon Sandstone. The author states that bedrock is 130 feet deep at I-6 (see Page. 3-37, paragraph 3).

86. Figure 3-18, Page 3-35.

M&E spot check shows that on the log of L-3 the driller reports shale at 16.5 feet. If this is the shale that overlies the Sharon, and we suspect it is, the top of rock is at 929 feet, meaning that the author's 925-foot contour needs to be adjusted.

87. Figure 3-19, Page 3-38.

With the limited data points available, how can Weston extend these contours west to a point beyond the railroad track? Metcalf & Eddy realizes the limitation of the data, but considering the previously estimated hydraulic connection between the three stratigraphic zones, wouldn't it be more reasonable, or at least as plausible that these contour lines curve around the cone of depression originating from production well W-10.

88. Figure 3-19, Page 3-39.

There is no basis for extending the contours as he does (beyond the railroad) and the contours probably do not have the configuration he shows, we nevertheless agree with the author that contaminated ground water probably is moving towards the plant wells (2nd paragraph).

89. Figure 3-20, Page 3-40.

Metcalf & Eddy finds Weston's contour interpretation questionable. Metcalf & Eddy interprets the data to reflect an elliptical cone of depression originating at well W-10 with the long axis trending NE, SW.

90. Figure 3-20, Page 3-40.

This map and accompanying interpretation are questionable. What can the author possibly mean by showing an "estimated dewatered zone" where the contours are shown to terminate? Those contours must loop around that area.

We know that the I wells are hydraulically connected to the deep wells in the Sharon Sandstone. During the aquifer test nearly a foot of drawdown was observed in I-4, I-5, and I-7, and about a half foot in I-6, after a little less than 2 days of pumping. The contours on Figure 3-20 should curve around the center of pumping, much like the contours for the "bedrock" wells shown in Figure 3-21. They replicate, at a somewhat higher level, the contours in the bedrock wells.

Another thing, Weston should use data from wells P-4 and P-5, both of which are screened at the interface?

Note - the author concedes (Page 3-38, last paragraph) that pumping well W-10 might affect I-4. He needs to take another look at Figure 3-13, which shows that drawdown occurred in all wells, deep, shallow, and interface, when W-10 was pumped.

91. Page 6.

"Table C-1" should be identified at the top of the page.

92. Page 7, Line 5.

Where is Table D-1?

93. APPENDIX E.

M&E analyzed the time drawdown semilog graphs for wells R-1, R-2, R-3, and R-5 (the graph for R-4 is not included) and got about the same values for T and S as those reported in table 3-6.

	T*	S (WESTON)	T*	S (M&E)
R-1	16,000	.001	16,600	.001
R-2	39,000	.001	39,500	.00084
R-3	12,000	.0001	11,645	.0001
R-4	68,000	.0006	-	-
R-5	26,000	.002	41,500 (1st slope)	.0013
			23,600 (2nd slope)	.0017

* gal/d-ft

There is fairly good agreement except for R-5, the value for transmissivity being dependent on which segment of the data plot is chosen. What Metcalf & Eddy finds most important, however, and which is not mentioned in the report is that all four of the graphs Metcalf & Eddy looked at show strong effects of a recharge source that shows up after a few hours of pumping. Without a doubt this recharge represents leakage from the overlying unconsolidated deposits. This is confirmed by the fact that drawdown was observed in wells in these shallow deposits during the test (see figure 3-13, Page 3-29).

As stated, contours of equal drawdown in the shallow wells probably will replicate those in the sandstone aquifer. Replication won't be exact, of course, because of the anisotrophy of the sandstone. Unfortunately, not enough data are available to draw the respective contour maps with much confidence.

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Waste Management Division
U.S. EPA, REGION V

10 November 1988

Mr. Walter Nied
U.S. EPA Region V
230 S. Dearborn St.
Chicago, IL 69604

W.O. #2994-02-03

Dear Mr. Nied:

Enclosed are the results of the soil gas analysis WESTON recently finished at the EKCO Housewares facility. After our discussions with Mr. McGuinness, we are transmitting the soil gas results and the proposed soil boring locations to you. We expect these documents will be the subject of our meeting on 15 November 1988 in the EKCO Housewares conference room.

If there is anything else you need, please do not hesitate to contact me at (215) 344-3643.

Very truly yours,

ROY F. WESTON, INC.

Harold G. Byer, Jr.

Harold G. Byer, Jr.
Project Manager

HGB\mq
Attachment

cc: Mr. T. McGuinness
Mr. T. Shingleton
Mr. M. Eggert

10-Nov-88

Note: Precise concentrations may change as the result of the final QC review. However, relative concentrations are accurate.

SOIL GAS SURVEY RESULTS
AMERICAN HOME PRODUCTS
EKCO FACILITY
(ppm)

SOIL GAS SAMPLE LOCATION	TRICHLORO-ETHENE	1,1,1-TRICHLORO-ETHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE
SG-01	11.2	5.6		
SG-02	NR	NR	NR	NR
SG-03	40	2.5		
SG-04	5.4	2.7		
SG-05				
SG-06	8.2	1.0		
SG-07	11	1.7		
SG-08	0.1	0.5		
SG-09	14.5	4.3		
SG-10	NR	NR	NR	NR
SG-11	2.4			
SG-12	1.8			
SG-13	0.5	0.1		
SG-14	4.9			
SG-15	1.0			
SG-16	0.8			
SG-17	0.4	0.1		
SG-18	0.6	0.1		
SG-19	0.1	0.02		
SG-20	0.05			
SG-21	0.1			
SG-22	0.03	0.1		
SG-23	0.1	0.1		
SG-24	610	160		
SG-25	15	9.2		
SG-26	3.0	0.2		
SG-27	NR	NR	NR	NR
SG-28	5.4	0.06		
SG-29	1.6			
SG-30	0.12	0.03		
SG-31	0.5			

N.R. - No Recovery

10-Nov-88

Note: Precise concentrations may change as the result of the final QC review. However, relative concentrations are accurate.

SOIL GAS SURVEY RESULTS
AMERICAN HOME PRODUCTS
EKCO FACILITY
(ppm)

SOIL GAS SAMPLE LOCATION	TRICHLORO-ETHENE	1,1,1-TRICHLORO-ETHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE
SG-32	0.07			
SG-33	0.2	0.3		
SG-34	0.3	0.06		
SG-35	0.01			
SG-36	0.2			
SG-37	0.06	0.06		
SG-38	0.04			
SG-39	0.5	0.04		
SG-40	8.2	0.16		
SG-40A	0.1	0.3		
SG-41	1.0			
SG-42	0.06			
SG-43	NR	NR	NR	NR
SG-44	0.2	0.4		
SG-45	0.2			
SG-46	0.2	0.06		
SG-47	0.07			
SG-48	0.01			
SG-49	6.6	0.1		
SG-50	2.0			
SG-51	1.1			
SG-52	0.08	0.01		
SG-53	6.3	0.02		
SG-54				
SG-55	0.2			
SG-17A	4.2	0.08		
SG-22A	5.5	2.2		
SG-23A	160	58	130	
SG-24A	62	15		
SG-25A	0.02	0.03		
SG-26A	8.4	2.5		10

NR - No Recovery

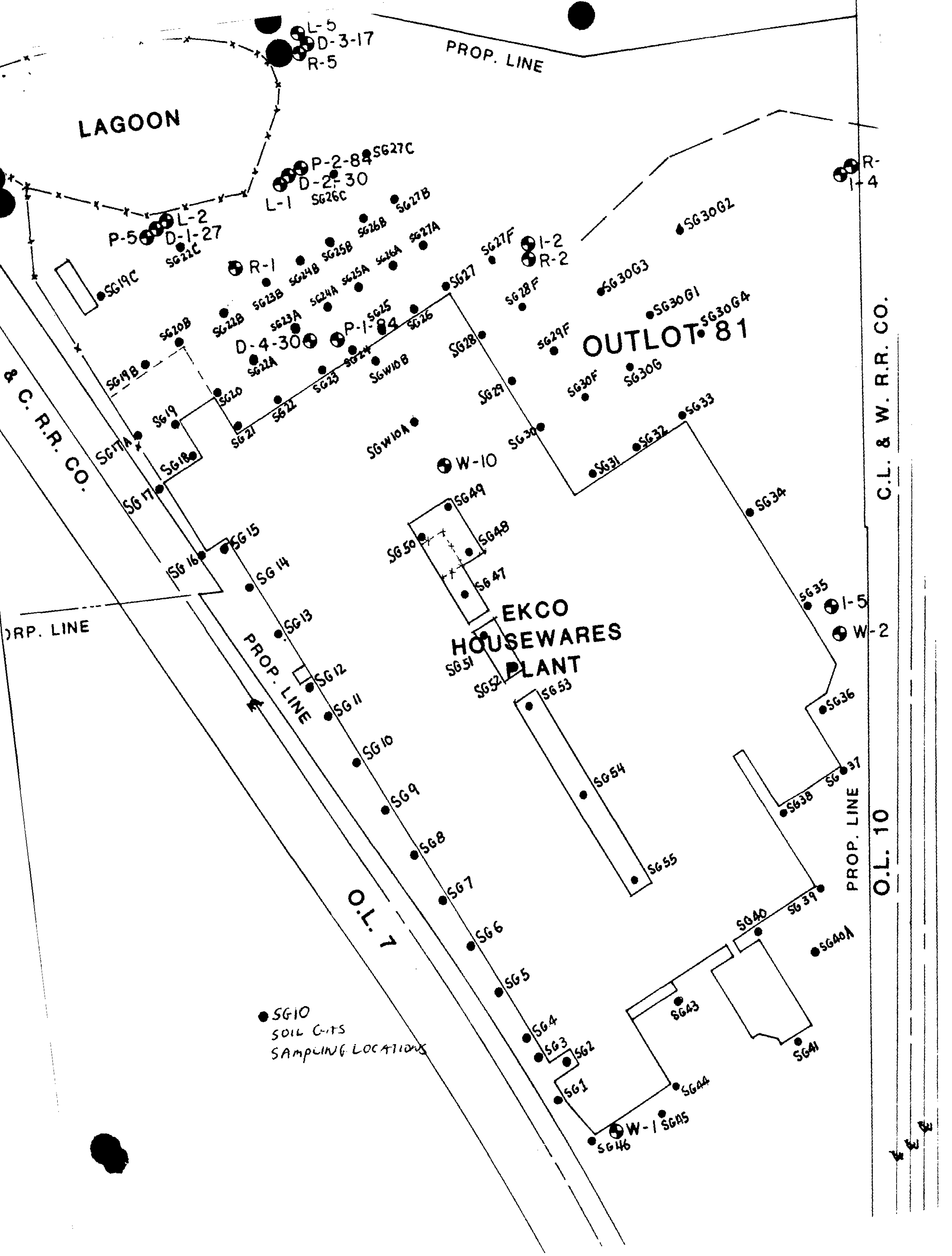
10-Nov-88

Note:Precise concentrations may change as the result of the final QC review. However, relative concentrations are accurate.

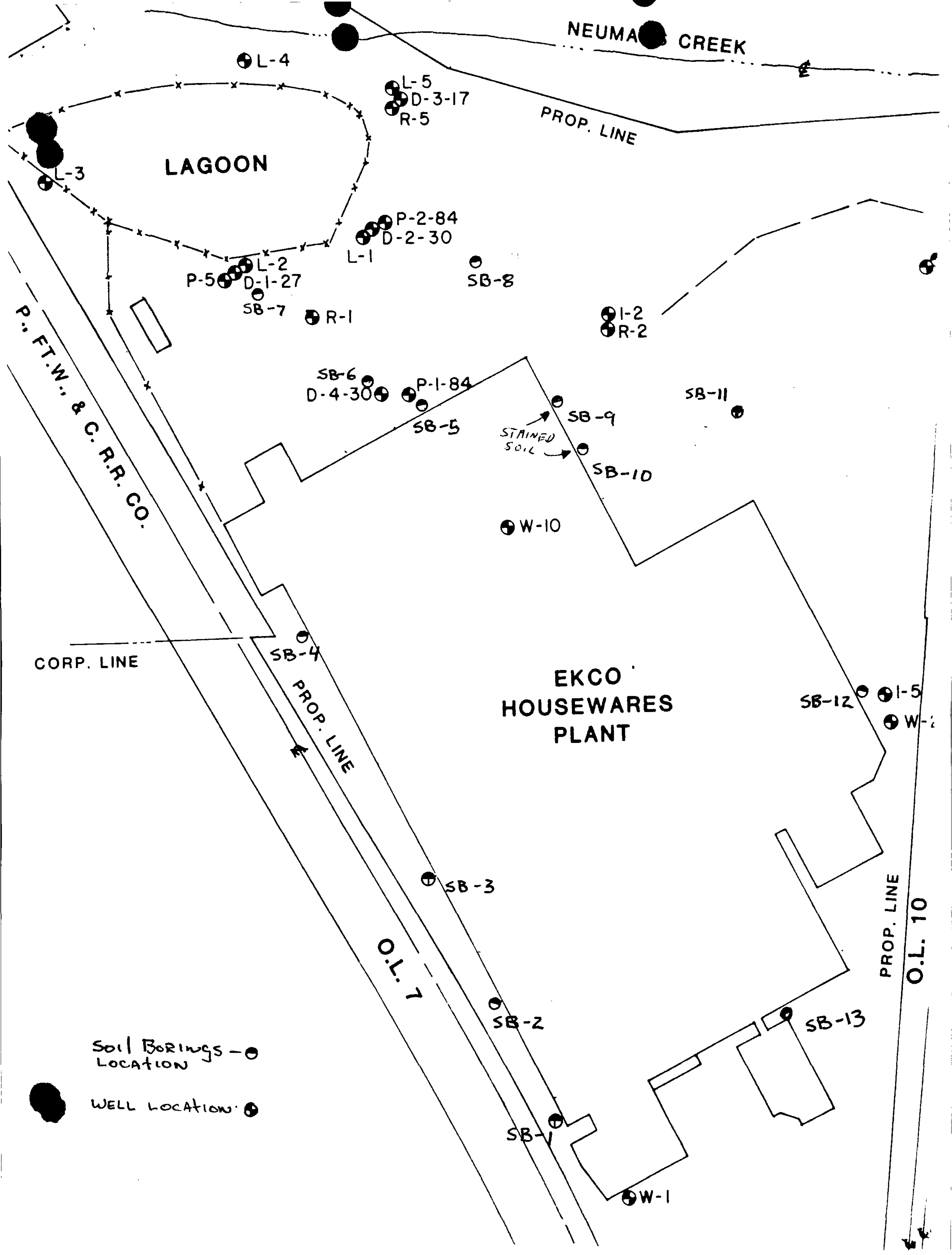
SOIL GAS SURVEY RESULTS
AMERICAN HOME PRODUCTS
EKCO FACILITY
(ppm)

SOIL GAS SAMPLE LOCATION	TRICHLORO-ETHENE	1,1,1-TRICHLORO-ETHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE
SG-27A	14	2.6		
SG-27E	0.8	0.06		
SG-19B	NR	NR	NR	NR
SG-20B	1.0			
SG-22B	3.9	0.02		
SG-23B	4.2	1.4		
SG-24B	0.4	0.1		
SG-25B	0.4	1.2		
SG-26B	1.0	0.2		
SG-27B	49	0.8	13	
SG-19C	0.02			
SG-22C	14	0.05		
SG-26C	0.2	0.03		
SG-27C				
SG-27F				
SG-28F	1.1	0.02		
SG-29F	0.04			
SG-30F	0.02			
SG-30G	3.2	0.07	0.5	
SG-30G1	3.4	31.2	15	3.7
SG-30G2	0.8	5.6		
SG-30G3	0.8	10	1.7	
SG-30G4	0.1			
SG-W10A	126	46	340	
SG-W10B	6.5	34	147	

NR- No Recovery



LAGOON
PROP. LINE
OUTLOT 81
EKCO HOUSEWARES PLANT
C.L. & W. R.R. CO.
& C. R.R. CO.
O.L. 7
O.L. 10
W-10
W-1
W-2
I-5
I-2
R-2
R-1
P-5
L-2
D-1-27
L-1
D-2-30
P-2-84
L-5
D-3-17
R-5
D-4-30
P-1-84
SG10
SOIL GAS
SAMPLING LOCATIONS



NEUMA S CREEK
PROP. LINE
L-4
L-5
D-3-17
R-5
LAGOON
L-3
P-2-84
D-2-30
L-1
L-2
P-5
D-1-27
SB-7
R-1
SB-8
I-2
R-2
P.. FT.W., & C. R.R. CO.
SB-6
D-4-30
P-1-84
SB-5
SB-9
STAINED SOIL
SB-10
SB-11
W-10
CORP. LINE
SB-4
PROP. LINE
EKCO
HOUSEWARES
PLANT
SB-12
I-5
SB-3
O.L. 7
PROP. LINE
O.L. 10
SB-2
SB-13
Soil Borings Location
WELL LOCATION
SB-1
W-1

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10 November 1988

Mr. Walter Nied
U. S. EPA REGION V
230 S. Dearborn St.
Chicago, IL 69604

W.O. #2994-02-03

Dear Mr. Nied;

Please find enclosed three copies of the revised Quality Assurance Management Plan (QAMP) for the implementation of the Groundwater Quality (GWQA) per you comments dated October 18, 1988.

All your requested changes have been incorporated with the exception of comments 5 and 10. We have not incorporated comment #5 for two reasons:

1. The production wells would most likely have to be shut down and dismantled to be sampled in the manner that your comment infers.

2. The objective of the sampling and analysis of the production wells is not to define the perimeter of the contaminated plume, since, the production wells are being used in the groundwater reclamation project.

Comment 10 was not addressed directly in this version of the QAMP because I-3 was not designed as an observation well in the September 1988 version of the QAMP. The observation wells well be clearly designated in the Pump Test Technical Memorandum to be submitted in the near future.

If you have any questions and/or comments, please do not hesitate to contact me at (215) 344-3643.

Very truly yours,

ROY F. WESTON, INC.

Harold G. Byer, Jr.

Harold G. Byer, Jr.
Project Manager

HGB/mq
Attachments
cc: T. McGuinness
M. Eggert, OEPA

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U.S. EPA, REGION V

8 November 1988

W.O. #2994-02-03

Mr. Thomas Shingleton
EKCO Housewares, Inc.
359 State Ave Extension, NW
Massillon, OH 44648

Dear Mr. Shingleton,

This will confirm our earlier conversation about the beginning of the soil boring and soil sampling effort.

The soil gas survey WESTON started during the week of 24 October 1988 was highly successful. As we discussed, WESTON will be using the results of the survey to select the soil boring locations. We expect to have the drilling rig and WESTON personnel arrive at the EKCO facility on Monday, 14 October 1988.

I would appreciate it if you could make your conference room available to the WESTON team as a centralized work area.

I have also been advised that U.S. EPA and OEPA will have observers on your site during all or part of the time the work is in progress.

Thank you for your continued cooperation during this project. If there are any questions, please contact me at (215) 344-3643.

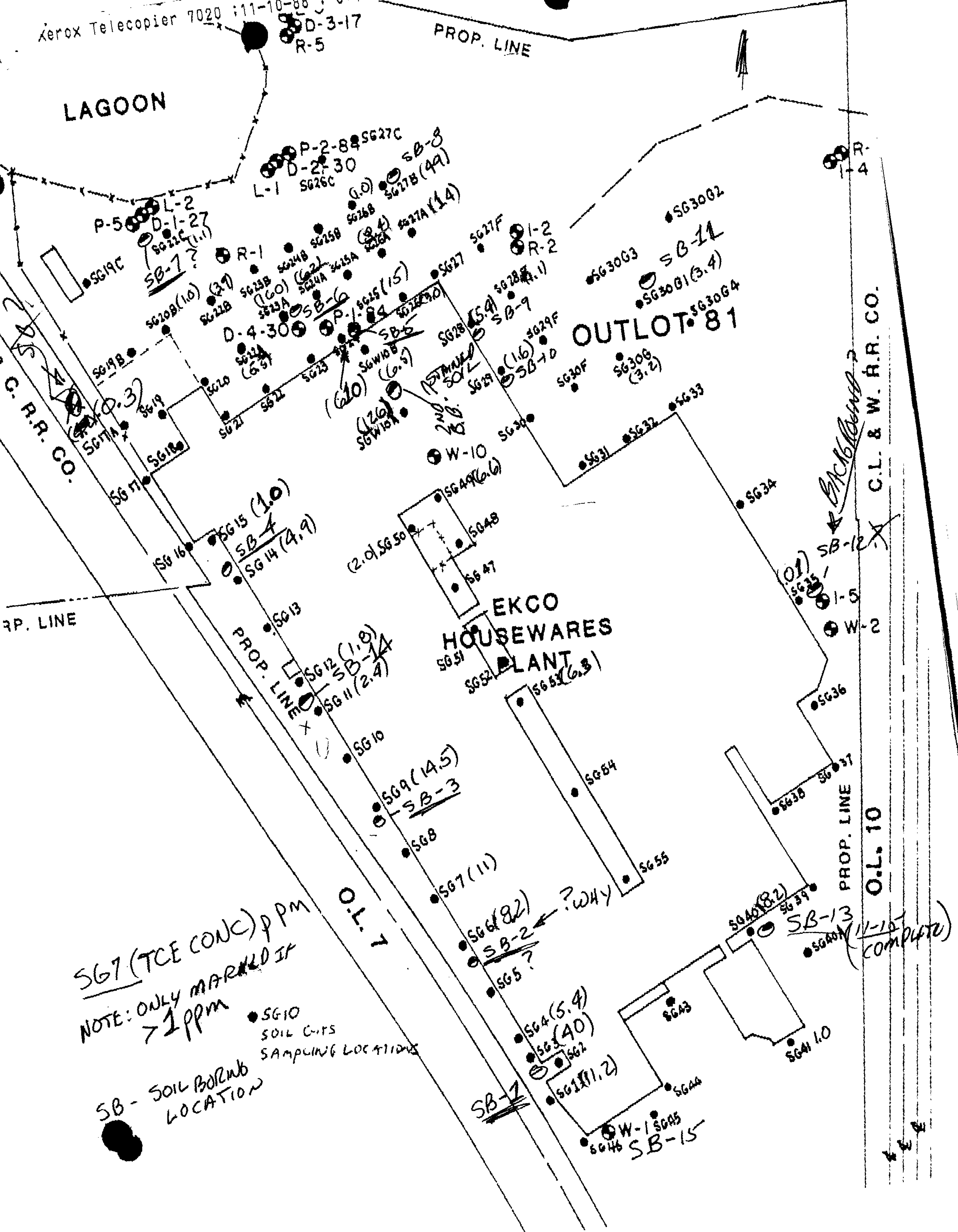
Very truly yours,

ROY F. WESTON, INC.

Harold G. Byer, Jr.

Harold G. Byer, Jr.
Project Manager

HGB/mq
Dr. M. N. Bhatla
Mr. T. McGuinness
Mr. R. Johnson
Mr. A. Mergenthaler
Mr. W. Nied


LAGOON
PROP. LINE
D-3-17
R-5
P-2-84
D-2-30
L-1
SB-8
L-2
P-5
D-1-27
SB-7?
R-1
SB-6
P-1-84
SB-5
D-4-30
SB-9
SB-10
SB-11
I-2
R-2
OUTLOT 81
W-10
C.L. & W. R.R. CO.
R-
I-4
BACKGROUND ?
SB-12
I-5
W-2
G. R.R. CO.
SB-4
EKCO
HOUSEWARES
PLANT
SB-14
PROP. LINE
SB-3
?WHY
SB-2
SB-13
(11-10
COMPLETE)
PROP. LINE
O.L. 10
O.L. 7
SB-1
W-1
SB-15
SG7 (TCE CONC) ppm
NOTE: ONLY MARKED IF
>1 ppm
SG10
SOIL GAS
SAMPLING LOCATIONS
SB - SOIL BORING
LOCATION

10-Nov-88

Note: Precise concentrations may change as the result of the final QC review. However, relative concentrations are accurate.

≥1ppm MARKED ON MAP

NOTE TOTAL 56 ≥ 1 ppm ≈ 38 OUT OF 86 ≈ 50%

SOIL GAS SURVEY RESULTS
AMERICAN HOME PRODUCTS
EKCO FACILITY
(ppm)

SOIL GAS SAMPLE LOCATION	TRICHLORO-ETHENE	1,1,1-TRICHLORO-ETHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE
SG-01	11.2	5.6		
SG-02	NR	NR	NR	NR
SG-03	40	2.5		
SG-04	5.4	2.7		
SG-05	RESULTS?	NON-DETECT (BLANK)		
SG-06	8.2	1.0		
SG-07	11	1.7		
SG-08	0.1	0.5		
SG-09	14.5	4.3		
SG-10	NR	NR	NR	NR
SG-11	2.4			
SG-12	1.8			
SG-13	0.5	0.1		
SG-14	4.9			
SG-15	1.0			
SG-16	0.8			
SG-17	0.4	0.1		
SG-18	0.6	0.1		
SG-19	0.1	0.02		
SG-20	0.05			
SG-21	0.1			
SG-22	0.03	0.1		
SG-23	0.1	0.1		
SG-24	610	160		
SG-25	15	9.2		
SG-26	3.0	0.2		
SG-27	NR	NR	NR	NR
SG-28	5.4	0.06		
SG-29	1.6			
SG-30	0.12	0.03		
SG-31	0.5			

N.R. - No Recovery

10-Nov-88

Note: Precise concentrations may change as the result of the final QC review. However, relative concentrations are accurate.

SOIL GAS SURVEY RESULTS
AMERICAN HOME PRODUCTS
EKCO FACILITY
(ppm)

MCL
V.C. 2 ppb

TCE ≥1 ppm ON MAP

SOIL GAS SAMPLE LOCATION	TRICHLORO-ETHENE	1,1,1-TRICHLORO-ETHANE	1,1-DICHLORO-ETHENE	1,1-DICHLORO-ETHANE
SG-27A	14	2.6		
SG-27E	0.8	0.06		
SG-19B	NR	NR	NR	NR
SG-20B	1.0			
SG-22B	3.9	0.02		
SG-23B	4.2	1.4		
SG-24B	0.4	0.1		
SG-25B	0.4	1.2		
SG-26B	1.0	0.2		
SG-27B	49	0.8	13	
SG-19C	0.02			
SG-22C	14	0.05		
SG-26C	0.2	0.03		
SG-27C				
SG-27F				
SG-28F	1.1	0.02		
SG-29F	0.04			
SG-30F	0.02			
SG-30G	3.2	0.07	0.5	
SG-30G1	3.4	31.2	15	3.7
SG-30G2	0.8	5.6		
SG-30G3	0.8	10	1.7	
SG-30G4	0.1			
SG-W10A	126	46	340	
SG-W10B	6.5	34	147	

NR - NO RECOVERY

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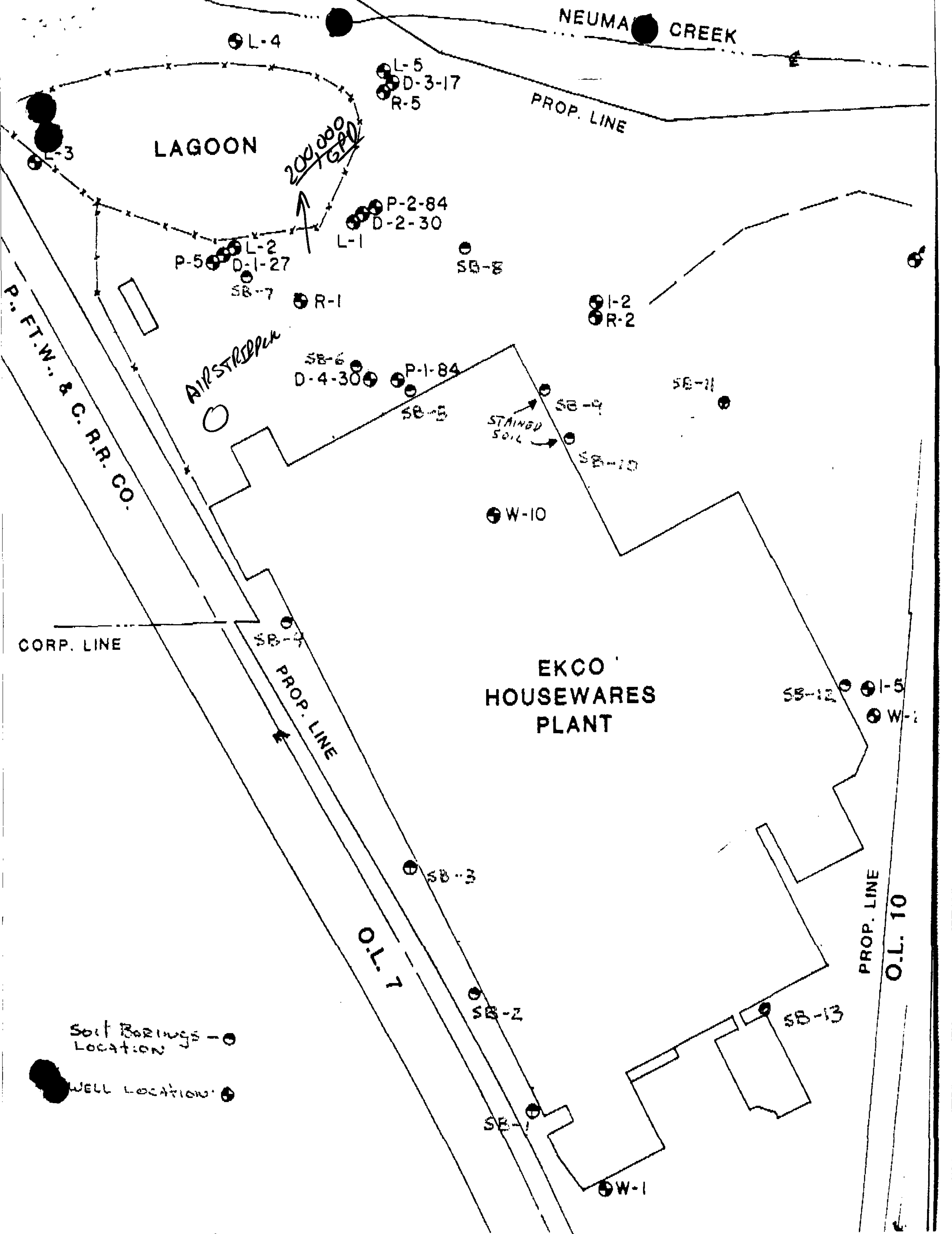


WESTON
MANAGERS DESIGNERS/CONSULTANTS
WESTON WAY
WEST CHESTER, PA 19380
PHONE: 215-692-3030
TELEX: 83-5348

18 August 1988

Mr. Walter F. Nied, Jr.
Hydrogeologist
U. S. EPA Region V
230 S. Dearborn Street
Chicago, IL 60604

W.O. #2994-02-03

RE: Well Location Map & Well Logs from EKCO Facility

Dear Mr. Nied:

Thank you for the productive meeting we had in Columbus, Ohio, this week.

Per your request, I am enclosing copies of the drilling logs and well construction summaries from piezometer P-4 and well I-4 recently drilled at the EKCO facility. Also, enclosed is a copy of the monitoring well location map for your convenience in locating all the wells at the site.

If there are any questions, please contact me at your convenience.

Very truly yours,

ROY F. WESTON, INC.

Harold G. Byer, Jr.

Harold G. Byer, Jr
Project Manager

HGB/mq

Attachment

cc: Mr. T McGuinness

WESTON

DRILLING LOG

WELL NUMBER: I-4 OWNER:

LOCATION: State Street Ext. Massillon, OH Next to R-4 ADDRESS:

TOTAL DEPTH 72.5'

SURFACE ELEVATION: 932.36' WATER LEVEL:

DRILLING COMPANY: Bowser-Morner DRILLING METHOD: HSA DATE DRILLED: 6/1/88

DRILLER: S.C. Patterson HELPER: Joe Patterson

LOG BY: L. Sherrerd Steele

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					
	5-7	1	SS	-	Silty clay, brown to orange brown, moist cohesive, intermixed with some medium sand and fine gravel, poorly sorted.
10	10-12	2	SS	-	Sandy silt, brown to orange brown intermixed with medium sand, cobbles and gravels (up to 2" in diameter), cinders, white granular material, very poorly sorted, wet.
	13-15	3	SS	-	Cobbles in a fine silty sand matrix grading into a fine clayey sand and back into a silty sand, well sorted, stratified, dark orange brown, wet.
	18-20	4	SS	-	Silty clay, medium brown, very loose with large gravel (up to 2" in diameter), subrounded to subangular and with medium sand, poorly sorted, wet.
20					
	23-25	5	SS	-	No recovery.
	28-30	6	SS	-	Clay, light to medium grey, cohesive, intermixed with medium-coarse sand and some gravels, poorly sorted, wet.
30					
	33-35	7	SS	-	As above but with fewer sand and gravel.
	38-40	8	SS	-	As above.
40					

* A.S.T.M. D1586

DRILLING LOG

WELL NUMBER: I-4
OWNER:
LOCATION: State Street Ext. Massillon, OH Next to R-4
ADDRESS:
TOTAL DEPTH 72.5'
SURFACE ELEVATION: 932.36'
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 6/1/88
DRILLER: S.C. Patterson
HELPER: Joe Patterson
LOG BY: L. Sherrerd Steele

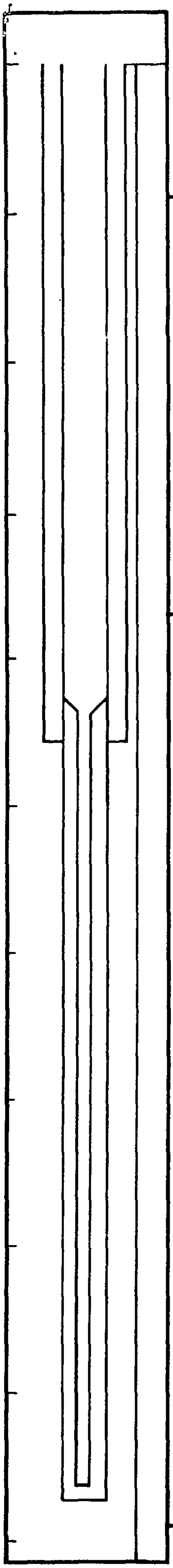
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40					
	43-45	9	SS	-	Gravel, light grey to grey, somewhat uniform, subangular, ¼"-1" diameter, with sand, medium to coarse, in a clay matrix, wet, poorly sorted.
	48-50	10	SS	-	Gravel, light grey to grey, subrounded to rounded (¼"-1" in diameter) in a fine to coarse sand matrix, trace silt, poorly sorted. Some larger cobbles (2" diameter) towards end of sample, wet.
50					
					55'-72.5': (No Split Spoon samples taken between these depths because material too large for the Spoon. The following lithology was described from bailer cuttings.) Large (2"-4" diameter rounded cobbles in a matrix of coarse sand and gravel.
60					
70					
					72.5': Bedrock.
80					

* A.S.T.M. D1586

Location Ekco, Massillon, OH
Personnel L. Sherrerd Steele
Project American Home Products



Well I-4

Well Construction Summary

Location or Coords: Adjacent to Site Well R-4

Elevation: Ground Level 932.36
Top of Casing 933.17

Drilling Summary:

Total Depth 72.5'
Borehole Diameter 8"

Driller Bowser-Morner, S.E. Patterson

Rig Cable tool rig
Bit(s) N/A

Drilling Fluid Potable water

Surface Casing N/A

Well Design:

Basis: Geologic Log X Geophysical Log ____
Casing String(s): C = Casing S = Screen

C	-	62.5	+2
S	-	72.5	62.5

Casing: C1 4" Low carbon steel

C2 N/A

Screen: S1 4" Stainless steel, type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from the bottom to 58' BGS

Cement Portland, Type I from 53' BGS to the surface.

Other o Seal: Bentonite slurry from top of sand to 53'BGS
o Protective casing

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 8"	6/1	0900	6/1	1645
Geophys. Logging:				
Casing:/Screen: 4"	6/2	0930	6/2	1100
Filter Placement:				
Cementing:	6/2	1120	6/2	1600
Development:	6/28	1000	6/28	1215
Other: SEAL	6/2	1100	6/2	1120

Well Development:

Very silty at first then cleared up. Developed by air lifting and well produced 5-6 gpm.

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

WELL NUMBER: P-4
OWNER:
LOCATION: 250' North of Newman Creek between Rail tracks, Massillon, OH
ADDRESS:
TOTAL DEPTH 108'
SURFACE ELEVATION: 936.60
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/18/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L. Lawlor

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0	3-5	1	SS	5-3 3-3	Silty clay, organic, black, nonstratified, weak cementation, with 30% gravel, moist.
10	8-10	2	SS	5-7 8-10	Clay, mottled with light grey, orange brown and black discontinuous clay lenses, nonstratified, stiff, moist.
	13-15	3	SS	13-43 45-47	Silty sand and gravel (subrounded up to 1½" diameter, 40%) grades from dark grey to light brown, weak cementation, possibly fill material, poorly graded, nonstratified, wet.
20	18-20	4	SS	36-27 22-21	Sand and gravel, 60% gravel up to 1½" diameter, subrounded, medium sand, some silt brown-orange brown, poorly graded, nonstratified, weak cement, saturated.
	23-25	5	SS	43-27 17-15	No recovery.
30	28-30	6	SS	21-20 18-19	fine-medium sand, well graded, nonstratified, saturated, brown, weak cement, some silt.
	33-35	7	SS	24-22 17-18	Silty sand and gravel, 30% gravel, up to 1½" diameter, subrounded, silty sand is grey-brown, saturated, (6" silt with gravel up to 1/8" diameter, moist, stiff grey), poorly graded, nonstratified.
40	38-40	8	SS	28-22 20-18	No recovery.

* A.S.T.M. D1586

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: P-4
OWNER:
LOCATION: 250' North of Newman Creek between rail tracks, Massillon, OH
ADDRESS:
TOTAL DEPTH: 108'
SURFACE ELEVATION: 936.60'
WATER LEVEL:
DRILLING COMPANY: Bowser-Morner
DRILLING METHOD: HSA
DATE DRILLED: 5/18/88
DRILLER: Joe Falbo
HELPER: Lee Bechtol
LOG BY: L. Lawlor

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
40					
	43-45	9	SS	15-12 15-29	Silty sand and gravel, 50% gravel up to 1" diameter, subrounded, grey-brown, silty sand, poorly graded, weak cement, saturated.
	48-50	10	SS	31-21 29-30	Silt with gravel, 30% gravel up to 1" diameter, subrounded-subangular, grey silt, moist stiff, nonstratified, poorly graded.
50					
	53-55	11	SS	15-47 37-37	As above.
	58-60	12	SS	21-22 50/5"	Silt, with 20% gravel up to 3/4" diameter, subrounded-subangular, grey, wet, stiff.
60					
	63-65	13	SS	50-36 25-25	Silty sand and 40% gravel up to 1½" diameter, subrounded, subangular, poorly graded, weak cement, grey, wet, nonstratified.
	68-70	14	SS	28-26 32-38	Silt with 10% gravel up to ¼" diameter, grey, moist, stiff, nonstratified.
70					
	73-75	15	SS	40-30 40-50/3"	Silt with 30% gravel up to ½" diameter, subrounded to subangular, grey silt, moist, stiff nonstratified, high plasticity.
	78-80	16	SS	20-18 17-22	Sand and gravel, up to 1½" diameter, subangular, medium-coarse sand, weak cement, nonstratified, saturated, gray, trace silt.
80					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: P-4

OWNER:

LOCATION: 250' North of Newman Creek between rail tracks, Massillon, OH

ADDRESS:

TOTAL DEPTH 108'

SURFACE ELEVATION: 936.60'

WATER LEVEL:

DRILLING COMPANY: Bowser-Morner

DRILLING METHOD: HSA

DATE DRILLED: 5/18/88

DRILLER: Joe Falbo

HELPER: Lee Bechtol

LOG BY: L. Lawlor

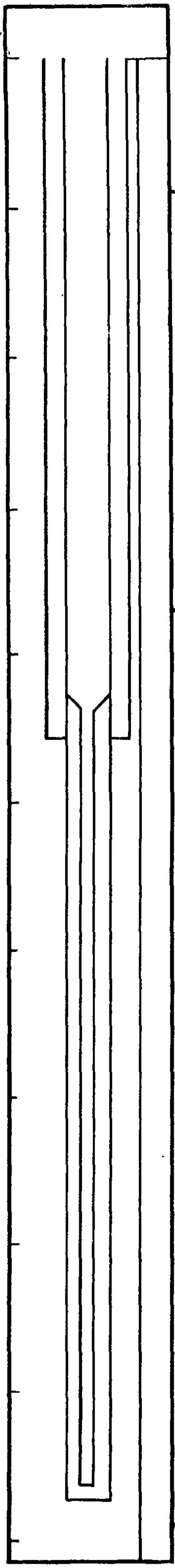
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
80					
	83-85	17	SS	30-27 32-29	Sand and gravel up to 3/4" diameter, subangular, coarse sand, saturated, weak cement, nonstratified, grey, some silt.
	88-90	18	SS	22-28 37-50	Silt with 30% gravel up to 1" diameter, subangular, grey silt, saturated, stiff, poorly graded.
90					
	93-95	19	SS	100/ 5"	No recovery.
	98-100	20	SS	75-100/3"	Silt and 40% gravel up to 3" diameter, subrounded, grey, saturated, stiff, nonstratified in top 5" of spoon. 5"-12": Sand and gravel up to 3" diameter, coarse sand, trace silt, weak cement, nonstratified, grey.
100					
	103-105	21	SS	100-100/5"	Sand and 60% gravel up to 3" diameter, subrounded, fine-coarse sand, grey, saturated, weak cement, poorly graded, nonstratified, trace silt.
	108'	22	SS	150/ 3"	Bedrock.
110					

* A.S.T.M. D1586

Location EKCO, Massillon, OH
Personnel L. Sherrerd Steele
Project American Home Products



Well P-4

Well Construction Summary

Location or Coords: 250' North of Newman Creek between Rail Tracks

Elevation: Ground Level 936.60

Top of Casing 938.48

Drilling Summary:

Total Depth 108'

Borehole Diameter 4¼"

Driller Bowser-Morner
Joe Falbo

Rig Hollow Stem Auger

Bit(s) N/A

Drilling Fluid Potable water

Surface Casing N/A

Construction Time Log:

Task	Start Date 1988	Start Time	Finish Date 1988	Finish Time
Drilling: 4¼"	5/18	1030	5/25	1715
Geophys. Logging:				
Casing:/Screen: 2"	5/26	0950	5/26	1005
Filter Placement:				
Cementing:	5/26	1330	5/26	1630
Development:	6/28	0930	6/28	1120
Other: Seal	5/26	1300	5/26	1315

Well Design:

Basis: Geologic Log X Geophysical Log ___

Casing String(s): C = Casing S = Screen

C	98	+2
S	108	98

Casing: C1 2" Low carbon steel with L.C. couplings

C2 N/A

Screen: S1 2" Stainless steel, type 304, 10 feet

S2 N/A

Centralizers N/A

Filter Material Natural sand pack from bottom to 92.5' BGS

Cement Portland, Type I from top of seal to surface.

Other o Seal: Bentonite slurry from top of sand to 88' BGS
o Protective casing

Well Development:

Water was very cloudy and silty at first. At finish it was slightly cloudy. Developed by air lifting. Pumped at a rate of 2-3 gpm.

Comments:

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT HAZARDOUS WASTE SITES

TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. 483

TECHNICAL REVIEW COMMENTS ON THE GROUNDWATER ASSESSMENT PLAN

AT

EKCO HOUSEWARES FACILITY
MASSILLON, OHIO
U.S. EPA REGION V

JACOBS ENGINEERING GROUP, INC.
PROJECT NO. 05-B635-00

WORK ASSIGNMENT PERFORMED BY:

METCALF & EDDY, INC.
6480 BUSCH BOULEVARD, SUITE 120
COLUMBUS, OHIO 43229

JANUARY 18, 1988

Metcalf & Eddy
Hazardous Waste
Management Division

6480 BUSCH BOULEVARD
SUITE 120
COLUMBUS, OHIO 43229
TELEPHONE (614) 436-5550

January 18, 1988

Draft

Mr. Dean Geers
Jacobs Engineering Group
222 S. Riverside Drive, Suite 1870
Chicago, Illinois 60604

Subject: Review Comments, Ground Water Assessment Plan at the Ekco Housewares Facility, Massillon, Ohio
Contract #68-01-7351
W.A. 483

Dear Mr. Geers:

We have completed our review of the Ekco Housewares Ground Water Assessment Plan. Enclosed please find our review comments on the above referenced document.

Today's submittal partially completes our Work Plan Deliverable 5 - "review of additional plans on reports", as established in Jacobs Engineering Group's, Inc. TES IV Contract #68-01-7351.

Please forward these documents to Mr. Walter Nied of the U.S. EPA, Primary Contact of W.A. 483.

Sincerely,

G. R. Myers
Work Assignment Manager

GRM:gem

cc: J-file

TABLE OF CONTENTS

List of Figures

1.0 INTRODUCTION

U.S. EPA has entered into a Consent Agreement with Ekco Housewares, Inc. under Section 3008(h) of RCRA in 1987. This action requires Ekco to conduct a RCRA Facility Investigation, Corrective Measures Study, and Corrective Measures Implementation (RFI/CMS/CMI) at their Massillon, Ohio facility. A corrective action alternative will be selected by U.S. EPA and implemented by Ekco at the completion of the RFI/CMS.

U.S. EPA has requested that the TES Contractor represent U.S. EPA and provide assistance in monitoring and inspecting any RFI/CMS/CMI work performed on-site, provide professional technical support personnel to review the Corrective Action Plan, draft and final RFI, CMS, CMI reports, and conduct an independent, preliminary hydrologeologic assessment of the Massilon, Ohio area.

Pursuant to the Consent Agreement and implementation of the RFI/CMS, Weston, Inc., on behalf of Ekco Housewares, submitted a Groundwater Assessment Plan to address groundwater conditions at the Ekco facility.

The plan contained the following sections:

- 1 - Introduction
- 2 - Environmental Setting
- 3 - Ground Water Assessment
- 4 - RCRA Closure Monitoring Plan
- 5 - Corrective Action Analysis
- 6 - Schedule

2.0 GENERAL DESCRIPTION/ GENERAL COMMENTS

The Ekco Housewares facility is in the eastern part of Massillon, on the USGS 7 1/2 minute, Massillon Quadrangle Stark County, Ohio - T10N, R9W (Figure 1). The area of concern is located due north of the juncture of the Penn Central and Baltimore and Ohio Railroads, south of Kelso Creek, and west of the Tuscarawas River. It is occupied by the Ekco Housewares, in Massillon, Ohio Plant, Massillon Division. The address is 359 State Avenue Extension N.W., Massillon, Ohio.

The reasons for concern in this area are that hazardous organic compounds have been detected in the groundwater. The source of the contamination is not yet known; however, the hazardous compounds are chlorinated organic solvents and their degradation products. The major reason for concern is the location of the contaminated groundwater with respect to the Massillon municipal well field. The Massillon municipal wells are owned and operated, under contract, by the Ohio Water Service Co. One well has already been abandoned because of contamination by the organic solvents and their degradation products. It is essential to prevent this contamination from reaching other city wells or private wells in the area.

The suspected source of contamination is located in an industrial and residential area about two-thirds of a mile west of the Tuscarawas River. Ekco Housewares, Inc. is one facility in the area known to have used the contaminants found in the groundwater, and is suspected of having released them to the environment.

Ekco Housewares maintained and operated an industrial waste water treatment lagoon until 1985. Approximately 200,000 gallons per day of industrial process waste water laden with the contaminants discharged to the lagoon with no surface discharge recorded from the lagoon. This indicates that the majority of the contaminated waste water was percolating through the lagoon bottom and into the groundwater at the facility.

The concentrations of some of the contaminants are so high in the groundwater in some areas at the Ekco facility that they approach their respective solubility limits in water. This is a serious problem because of the potential for contaminant migration in the groundwater as free product along zones or surfaces of low permeability.

In communications with Mr. Rodney Beals of the Ohio EPA, Ekco has acknowledge that several "spills" of the contaminant raw products may have occurred and gone unreported by employees at Ekco. These spills may be reflected by the high concentrations of contaminants seen in the groundwater at the Ekco facility.

It is common knowledge in the chemical waste industry that TCE and 1,1,1-TCA degrade through physical, chemical, and biological action to less chlorinated hydrocarbon species. The end product of may of these processes in vinyl chloride and trichloroethene are 2.0 ppb and 5.0 ppb. However, the recommended maximum contaminant level for both of these compounds is 0. As TCE and 1,1,1-TCA degrade, a corresponding increase in the other chlorinated degradation species will take place, such as is seen to occur at the Ekco facility.

The Ekco plant has been in operation from at least 1945 with current manufacturing processes continuing since that time. The plant has interim status under RCRA Hazardous Waste Management Regulations to generate and store hazardous waste. Additionally, the facility has an Ohio NPDES permit to discharge industrial waste water to Newman Creek and the Tuscurawas River.

3.0 TES-IV CONTRACTOR REVIEW COMMENTS

This section contains the TES Contractor's comments on the sections listed above.

Review Comments: Section 1 - Introduction

1. Introduction, page 1-1, paragraph 1: The last sentence should indicate that the "evaporation pond" was a process waste water infiltration and evaporation pond.

2. Page 1-1, paragraph 2: The last sentence does not belong in this section because this section does not address corrective measures technologies. The "no-action" alternative given here "natural flushing of the soils..." is inappropriate because of documented offsite contaminant migration. It should be removed.

3. Page 1-1, paragraph 3: The first sentence should be changed from "...closure plan for the evaporation lagoon facility..." to "...closure plan for the waste water pond...".

4. Page 1-2, paragraph 1: One of the six objectives of the plan, listed on p. 1-2, is to define ground-water flow directions. In the plant area this has already been determined reasonably well, where the direction of movement is controlled by the cone of depression caused by the remedial pumping of well W-10. What is needed is information on groundwater movement outside this cone, between the plant and public supply wells 1, 2,

2,000

and 3, located about ~~1,000~~ feet northeast of the plant. The TES Contractor recommends that monitoring well clusters be installed between the Ekco facility and OWS wells 1,2, & 3.

5. Page 1-2, paragraph 1: Is the fourth item listed in this paragraph an objective of the overall RFI/CMS or the Groundwater Assessment.

6. Page 1-2, paragraph 3: The report states that a "wide variety of businesses operate in the vicinity of the Ekco plant". They list half a dozen businesses, none of which would likely generate much industrial waste, and none of which appear on the one-mile radius map, Figure 11. None of the three businesses that do appear on Figure 11 are listed, nor is anything said about them. Are any of them known generators of industrial wastes?

7. Page 1-1, paragraph 5: The site should be surveyed so that reference points and elevations are expressed with respect to an established National Gedoetic Vertical Datum (NGVD) and all water level measurements should be taken to .01 foot, as indicated in the Technical Enforcement Guidance Document (TEGD; September 1986).

8. Page 1-4, paragraph 3: What were the new regulations and permit requirements referred to in the second sentence?

9. Page 1-4, paragraph 4: What pollutants were covered by the NPDES permit? What was/were the discharge limits of the permit?

10. Page 1-5, paragraph 2: Was the lagoon operated under permit when it was brought back on-line from 1980 thru 1985? Provide details on the permit type, number, conditions, etc. if applicable.

11. Page 1-5, paragraph 5: Are the test holes and piezometers sealed below their respective water level? Additional details about well and test hole construction should be provided in this section.

12. Page 1-8, paragraph 2: The numerous references in this report to closure of the "evaporation lagoon" are puzzling. The last paragraph on p. 1-1 seems to say that the discussion of curcial parts of the hydrology, those relating to infiltration through the ground and into Newman Creek (if we have deciphered it correctly) will not be given here, but will be addressed in a forthcoming report on the "groundwater assessment for the evaporation lagoon".

13. On p. 1-8, paragraph 2: Apparently, the infiltration/evaporation lagoon was taken out of service in December 1985, and subsequently pumped (or siphoned) dry. In June 1986, Floyd Brown Associates installed several test borings (four in the bed of the dry lagoon) and developed a "preliminary closure plan". The test borings are shown in Figure 4, referred to as "phase I soil borings". In July 1987, Weston was contracted to begin "development for a final closure program for the lagoon". Nothing more is said about all this, but evidently more drilling was done. Figure 5 shows the location of 19 additional soil borings in the lagoon evidently done by the Floyd Brown firm as part of "phase II soil borings". It is interesting to see that so many borings would be deemed

necessary in such a small place. Nineteen soil borings, in addition to those collected during "Phase I", is an excessive number of borings. These borings should have been located elsewhere on the facility property. One wonders what they were looking for?

14. Page 1-23, paragraph 1: In the third item listed, there is no way for Weston to know whether all water wells were identified within a one mile radius.

Review Comments: Section 2 - Environmental Setting

1. Regional Geology, page 2-1: Descriptions of the regional geology are very poor. Where in northeast Ohio is the valley fill 500 feet thick? Where is the reference for the statement concerning the valley fill. And where, too, is the reference for the statement relative to the regional dip? It may indeed range between 20 and 40 feet per mile, but how does Weston know? And how about "occasional" limestone units; one day you see them and the next day you don't? Weston means "interbedded limestone units" here and should state it as such.

2. Page 2-1, paragraph 1: The description of the regional geology seems to disregard the significant outwash valleys. A brief discussion of their impact on the regional geology should be included in this section.

3. Page 2-7, paragraph 2: Weston says that the Tuscarawas Valley contains as much as 285 feet of unconsolidated material, and tributary valleys have up to 270 feet of material in them. Drift thickness maps of the Ohio Division of Geological Survey show a little over 200 feet of fill in the Tuscarawas Valley and much less in

tributary valleys. Where did Weston get this information? Further, Weston says that drilled wells in this area range in depth up to 500 feet; is Weston talking about water wells?

4. Page 2-9, paragraph 3: Are the wells adequate to use for measuring the groundwater elevations in, and the vertical head difference between the sandston and outwash aquifers?

5. Page 2-9, paragraph 4: It is assumed that where Weston says the gradient is obscured by the cone of the depression shown in Figure 12, they mean the regional gradient.

6. Page 2-13: Weston states that the unconsolidated sediments and the "Pottsville Sandstone" (Weston means Sharon Sandstone) "function as two separate hydrologic units". Weston doesn't really believe this for on p. 3-1 Weston talks about ways to assess the "hydrologic interconnection" between them.) On p. 2-13, Weston goes on to say that ground-water flow in the unconsolidated sediments appears to be southeast towards the Tuscarawas River, a statement based, no doubt, on the contours on Figure 13. A study of Figure 13 will show:

    a. The direction of movement in the vicinity of the lagoon is southeast, as Weston states, but not, as Weston suggests, in response to the regional gradient but very probably in response to the cone of depression around well W-10 (see Figure 12).

    b. There are no data points on Figure 13 to justify extending the contours beneath, and perpendicular to, Newman Creek. The TES Contractor contends that additional data would show the contours to curve southward around well W-10, to replicate the cone of depression in the Sharon Sandstone (see Figure 12). Thus, the contours would lie parallel with Newman Creek, consistent with the possibility that recharge is being induced from the stream.

c. There are no water-level data points in the unconsolidated sediments east, west, and south of well W-10; the TES Contractor believes such data would show conclusively that groundwater levels in the unconsolidated sediments conform generally to the pumping cone in the sandstone. With this in mind, the TES Contractor suggest the installation of additional shallow monitor wells north and east of the plant to augment those already proposed for the locations shown in Figure 14.

Figures and Tables

1. At our November 24, 1987 conference the TES Contractor and the U.S. EPA made a plea that well and groundwater elevations be referenced to sea level in the reports and plans. Ekco Co. representatives agreed.

2. Figures 8 and 9: The TES Contractor disagrees with the cross sections, Figures 8 and 9. In Figure 8, the Sharon Sandstone is broken into two units, a sandstone above and "alternating layers of shale and sandstone" below. Both of these disappear on Figure 9, where we have sandstone "interbedded with thin lenses of shale". Whomever "generated" (see 2-1) these cross sections for Weston never looked at them side by side.

Also why did the "clay, stones" at well R-4 in Figure 8 change to "clay, sand and gravel" at the same well in Figure 9? The "clay, stones" layer in Figure 8 suggests glacial till. White's glacial map (Bull. 61, Geology of Stark Co.) shows only sand and gravel and allivium in the plant area.

Review Comments: Section 3 - Ground Water Assessment

1. Page 3-1, paragraph 3: Weston proposes a pumping test to determine "transmissivity, flow directions, and hydraulic gradient". It is not clear how a 48-hour cessation of pumping in well W-10 (after which pumping is to be resumed) will add much practical knowledge of flow directions and hydraulic gradient. Normal regional gradients probably won't be re-established in 48-hours, certainly not if the public supply wells continue to be pumped.

   Weston evidently believes (see item 9, p. A-1 of the Groundwater Assessment Plan) that they can determine the transmissivity of both the sandstone and the unconsolidated deposits by pumping a well in the sandstone. This simply is not possible.

   Although in a situation like this a pumping test is considered "scientific", and almost mandatory, the TES Contractor believes that the data from the proposed test will be so hard to interpret that any and all results will be suspect. Consider the problems:

   a. First, we have a heterogeneous aquifer; there are numerous shale interbeds and markedly different levels at which the driller reported "most water pickup" in the test wells. Second, the wells are near the edge of the sandstone aquifer, where it thins and eventually terminates at the edge of the buried valley. Will the outwash deposits in the buried valley act as a positive boundary?

b. Second, and promising to further complicate the test results, is the probability that leakage from the unconsolidated sediments into the sandstone will occur during the test. (If the TES Contractor's hypothesis relative to a cone of depression existing in the unconsolidated sediments is correct, leakage is certain to occur.) If it occurs, such vertical leakage won't be uniform. Some of it may follow down the bores of poorly-seated wells nor, because of anticipated head changes during the test, will it occur at a constant rate. It seems likely to that during early pumping the head in the unconsolidated deposits will decline, but eventually because of the discharge of the test well into Newman Creek, water probably will reenter the unconsolidated sediments by induced infiltration and raise the head, at least locally.

c. The TES Contractor recommends that the proposed test be less complicated than the above scenario suggests, and that a convincing value for aquifer transmissivity can be obtained. It should be remembered that if pumping is not held constant in the plant supply wells, interpretation of the data may be even more difficult than the TES Contractor has suggested.

d. It is not stated how the discharge from the pumping well will be measured. The TES Contractor assumes that Weston is aware of the necessity of accurately determining the discharge (such as by use of an orifice pipe and manometer) and in keeping the discharge constant. A fluctuating pumping rate will add even more problems in interpretation than those the TES Contractor has already mentioned. Also, a staff gage should be installed in Newman Creek and read periodically during the test. Changes in stream stage might affect water levels in nearby wells.

2. Page 3-1, paragraph 3: Pump testing the sandstone aquifer will probably have little impact on the outwash aquifer if they are two distinctly separate hydrologic units, as Weston indicates in the report.

3. Page 3-1, paragraph 4: The slug tests that are proposed here cannot be run with wells screened above the water table because the zone of aeration will be tested in addition to the water table. The values generated by this test would not reflect the true characteristics of the water table aquifer.

4. Page 3-1, paragraph 3: Slug tests are not adequate enough to judge the whole site. They only provide information on the aquifer characteristics in a very localized area around the well in question. Pump tests should be used instead of slug tests.

5. Page 3-1, paragraph 6, et. seq.: The sandstone unit that Weston refers to in the text is the Sharon Sandstone (Bulletin 61, Division of Geological Survey) not the Pottsville Sandstone.

6. Page 3-2, paragraph 1: An additional monitoring well should be installed just north of well D-2-30 to replace the abandoned D-2-30 as a monitoring point.

7. Page 3-2, paragraph 2: An additional monitoring well should be installed into the outwash aquifer adjacent to the "south well" - well W-1. This should be done so that a monitoring well in the outwash aquifer is located on the south side of the plant. Additionally, since contamination has been found in bedrock well W-1, the outwash aquifer should be monitored in the immmediate vicinity of well W-1.

8. Page 3-2, paragraph 3: Three of the four offsite monitoring wells indicated in the plan are single wells not clusters. These should be monitoring well clusters that screen the entire thickness of the outwash aquifer, including the bedrock interface. Because the concentration of some of the contaminants have approached their solubility limits in the groundwater, free phase migration of these contaminants may occur along discrete planes of low permeability in the outwash aquifer.

9. Page 3-2, paragraph 1: No proposed monitoring wells are located north-northeast of the Ekco facility, between Ohio Water Service wells 1, 2, and 3. At least two well clusters should be placed between the facility and the municipal wells as both early warning and intercept wells.

10. Page 3-2: Consider screening the bedrock interface as well.

11. Page 3-2, paragraph 3: What about phased installation of the wells as an option? Run groundwater and plume models prior to installation.

12. Page 3-2, paragraph 3: Only one monitoring well cluster (2 wells), located due east of the facility, was proposed in this plan. There should be at least two additional monitoring well clusters located between the plant site and OWS wells 1, 2, and 3 to detect any contamination migrating toward the municipal wells. The well clusters should screen the entire thickness of the glacial outwash and the bedrock interface. These and all monitoring wells must thoroughly characterize and define the horizontal and vertical boundaries of the contaminant plume, as indicated in the Technical Enforcement Guidance Document (TEGD; September 1986).

13. Page 3-4, paragraph 2: Should the last sentence be worded "...upstream... downstream of the lagoon area". Additionally, the surface water sample locations are not indicated on a map in this section. Move the map from the appendix to page 3-5, the first page after it is referenced in the text.

14. Page 3-4, paragraph 2: Where are the stream water samples located with respect to the lagoon discharge? What is the justification for their locations?

15. Page 3-4, paragraph 3: What is the justification for the stream sediment sample locations? As with the surface water samples, the sediment sample locations are not indicated on a map in this section. Also, one sediment sample should be taken at the Ekco outflow pipe.

16. Page 3-5, paragraph 2: Weston should establish a facility-wide grid, not just a localized grid, with contingencies to go to a smaller grid size in "hot" zones. A facility-wide grid eliminates the possibility

of overlaping sampling grids or of unsampled areas. Define what contaminant level indicates a "hot" point/area.

17. Page 3-5, paragraph 5: The TEGD (Sept. 1986) indicates that all "hot" areas should be sampled in addition to the thirteen (13) point sources. This will aid in characterizing the extent of the contaminant plume.

18. Page 3-7, paragraph 1: This whole paragraph warrants a discussion justifying the purpose and need for this sampling. Construction/installation details of this should be included here as well.

19. Page 3-7, paragraph 3: Monitoring wells and well clusters within the plume boundaries should be used to characterize the interior of the plume. In order to characterize the plume, monitoring well cluster may be necessary so that the entire thickness of outwash is screened, including the bedrock interface.

    The detection limit for all organic analyses being performed should be 1 ppb using ASTM purge and trap methods.

    All sampling data should be presented in tabular and x-y graphical forms for ease of interpretation. X-Y graphs should be presented as concentration of contaminants thru time.

Figures and Tables

1. Figure 14: Figure 14 is a very poor map in the TES Contractor's view, it would have been much more informative if the scale were smaller so that the river

and public supply wells could have been shown. If the supply wells were shown, the TES Contractor believes it would be evident that there is a need for monitor wells on the far side of Newman Creek. Sampling of such wells would show whether contaminants may have escaped from the immediate vicinity of the plant prior to the start of the remedial pumping. Also, groundwater levels north of the creek would help define the direction of movement in the unconsolidated materials.

2. Page 4-4, paragraph 1: No hydraulic information has been provided. A discussion of this topic should be included in this section.

Review Comments: Section 5 - Corrective Action Analysis

1. Page 5-1, paragraph 1: The TES Contractor takes exception to the first paragraph in Section 5 (p. 5-1) where it says, "Ground water modeling will be performed ... to evaluate the effectiveness of the on-going groundwater recovery program and air stripping activities relating to the removal of contaminants ...." Only field evidence can show how well the groundwater clean-up is proceeding; the computer won't tell you. Also, it seems that the long narrative in the rest of Section 5, explaining in needlessly complicated technical jargon how a model works, is designed not so much to inform but to bestow an odor of sanctity on a vague and unconvincing agrument that a computer model is absolutely necessary to this project.

   Assume that a computer model can be constructed that will replicate reasonably well the field data in the vicinity of the plant, in an area near the lateral limits of a rapidly thinning, heterogeneous sandstone aquifer overlain by a variable thickness of silt, clay, and outwash, just how useful would such a model be in predicting the direction and rate of movement of a contaminant that may have moved from the plant area into the very different hydrologic environment represented by the thick and highly permeable outwash aquifer in the Tuscarawas River Valley? Would Weston build another model, or would they put in a few wells and see what is really happening? Provide documentation supporting the use of the proposed modeling package(s), as indicated in the TEGD (Sept. 1986).

2. Page 5-1, paragraph 2: No preliminary modeling results are presented to justify monitoring well locations. Modeling should estimate rate, extent, and concentration of contaminants at different times and locations.

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Ground Water Quality Assessment Plan for EKCO Housewares, Inc., Massillon, Ohio

RECEIVED
U.S. EPA REGION V
WASTE MANAGEMENT DIVISION
OFFICE OF THE DIRECTOR

March 1988

WESTON
MANAGERS DESIGNERS/CONSULTANTS

EXECUTIVE SUMMARY

This Ground Water Quality Assessment Plan (GWQAP) has been prepared in response to a partial Consent Agreement between USEPA Region V and EKCO HOUSEWARES, INC. signed November 1987. The GWQAP outlines the scope of work required to assess ground water conditions under the EKCO facility. Compounds detected in previous sampling include volatile organic compounds trichlorethylene (TCE), 1,1,1-trichlorethene (TCA), vinyl chloride and dichloroethylene.

Ground Water Assessment Programs are required at hazardous waste management units when the units are being closed under interim status and where the ground water monitoring indicates hazardous waste constituents in the ground water from the unit. Ground Water Assessment Programs are required to:

- o Determine the rate and extent of migration of concentrations of hazardous waste constituents in ground water;
- o Determine the concentration of hazardous waste constituents in the ground water.

Therefore, the GWQAP is required to specify:

- o The number, location and depth of wells;
- o Sampling and analytical methods for those hazardous wastes or hazardous waste constituents;
- o Evaluation procedures;
- o Schedule of implementation.

Other factors were also considered in the development of the GWQAP. These are:

- o Sources of ground water contamination other than the lagoon may exist. The scope of the Ground Water Assessment Program has been expanded to include an assessment of these potential additional contaminant source areas. These sources may include product storage areas, waste handling areas and contaminated soils outside of the impoundment.

- A ground water recovery and treatment system has been in operation since 1985. The Ground Water Quality Assessment Program will include the use of a ground water model to evaluate the present effectiveness and future modifications of the Ground Water Recovery and treatment system.

In order to meet the minimum requirement and factors referenced above a phased scope of work is planned. Phase 1 of the data collection activity is outlined in detail in this GWQAP. Additional phases of investigation will logically evolve from the data obtained during Phase I.

Phase I data collection includes field activity and laboratory analysis of environmental samples. The scope of work involves three specific objectives.

- The first objective is to define the lateral and vertical extent of the ground water contamination plume. This will involve placing nested monitor well pairs beyond the extent of known ground water contamination. Most of these wells will monitor the unconsolidated aquifer which thickens to the east, north and south of the plant.

- The second objective is to characterize potential sources. These sources include known product storage areas as well as areas where spills have been reported in the past. These sources may have provided contamination in the unsaturated soils directly beneath the surface which in turn become continuing sources of contamination to the ground water table. A soil gas survey followed by a subsurface soil sampling program will be implemented to define these potential sources.

- The third objective is to define the direct impact of ground water and surface water from the waste impoundment itself. The results of this activity will also be used to develop the facility closure plan. To accomplish this, five ground water monitoring wells will be placed in the shallow waterbearing zone around the impoundment. Direct sampling will occur of the sludge and subsurface soils beneath the impoundment. Samples of water and sediments will also be taken from Newman Creek which flows adjacent to the surface impoundment.

Based on the data collected during Phase 1, Phase 2 investigation may be required to complete the definition of the lateral extent of the ground water contamination plume, monitor ground water quality within the plume near source areas identified in Phase 1, and quantify the extent of contaminated soils in such areas identified in the Phase 1 soil gas survey. If contamination of Newman Creek is observed, a Phase 2 sampling program may be required to complete the definition of surface contaminant migration.

The specific Phase 1 scope of work includes:

1. The placement of nine (9) monitor wells beyond the lateral and vertical extent of known ground water contamination.

2. A soil gas survey followed by a subsurface soil sampling program to define the potential sources of contamination.

3. The installation of five (5) ground water monitoring wells in the shallow waterbearing zone around the abandoned surface impoundment.

4. The direct sampling of the sludge and subsurface soils at specific depth intervals beneath the impoundment.

5. The sampling of water at three locations and sediments at five locations in Newman Creek.

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SECTION 1

INTRODUCTION

1.1 PURPOSE AND SCOPE

Ground water beneath the EKCO Plant property may contain organic compounds currently listed on EPA's Hazardous Substance List (HSL), including trichloroethylene (TCE), 1,1,1-trichloroethane (TCA), vinyl chloride and dichlorethylene. Some of these compounds are associated with plant activities and may be in the ground water because of a series of past spills and leaks. The on-site surface impoundment may also be a source of volatile organics.

Since early 1985, EKCO, with approval from Ohio EPA, has conducted a ground water recovery program which includes continual pumping of ground water from two production wells and treatment of that water in an air stripper. Discharge is ultimately to Newman Creek under a NPDES permit. Ohio EPA outlined the reporting requirements for production well monitoring, air stripper emissions monitoring, monitor well sampling, water level monitoring, and city well sampling. The agency also, in a letter to EKCO dated 27 April 1985, stated that the cleanup of contaminated soils (outside of the lagoon) through natural flushing of the soils and eventually recovery of ground water is a "viable approach", if effective.

The purpose of the ground water quality assessment plan is to address ground water conditions at the EKCO plant proceeding under Section 3008(h) of the Resource Conservation and Recovery Act of 1976, as amended, U.S.C. 6928(h) and as part of the closure plan for the surface impoundment facility, particularly in reference to 40 CFR Section 265.93. Issues under this section include potential adverse effects on the ground water beneath the site, the direction of ground water flow, the proximity of surface waters, existing background quality of ground water, and possible other sources of contamination. Other issues include the existing quality of surface water hydraulically connected to the lagoon, other sources of contamination to surface water, and current and potential uses of ground water in the area. The ground water quality assessment for the surface impoundment will address those issues in 40 CFR Section 264.93.

The objectives of the ground water quality assessment are as follows:

- o To define ground water flow direction. To identify vertical and lateral extent of ground water contamination.
- o To define the depth and extent of soil contamination. To determine the impact on ground water quality.
- o To identify other sources (present or past) of on-site contaminants to ground water.
- o To evaluate the effectiveness of the ground water recovery and air stripping activities relating to removal of organics in the soils and ground water.
- o To identify the need for additional analytical sampling needed to complete the RCRA site closure and the facility site assessment.
- o To establish a compliance ground water monitoring program for the lagoon closure.

1.2 SITE LOCATION

The EKCO Housewares, Inc. facility occupies approximately 13 acres on 3rd Street N.W. in the town of Massillon, Stark County, Ohio (see Figure 1). The area surrounding the site is largely urban and industrial. Land use to the northwest is more rural with a larger proportion of open space. The EKCO Property is triangular in shape and lies an estimated 1,500 feet west of the Tuscarawas River. The facility is bordered to the north by Newman Creek, while the Penn Central and the Baltimore and Ohio Railroads border the EKCO Property to the west and east, respectively.

A variety of businesses operate adjacent to the EKCO Plant. These include Ohio Packaging (paper) to the south, sand and gravel quarries to the west and northwest, Carter Lumber (retail) and American Drain Pipe (concrete pipe) to the north and the Ohio Water Service (public water supply) waterworks to the east. The Baltimore and Ohio Railroad has numerous spurs and sidetracks adjacent to the EKCO Plant which are used for the storage of rail cars and Conrail track maintenance vehicles.

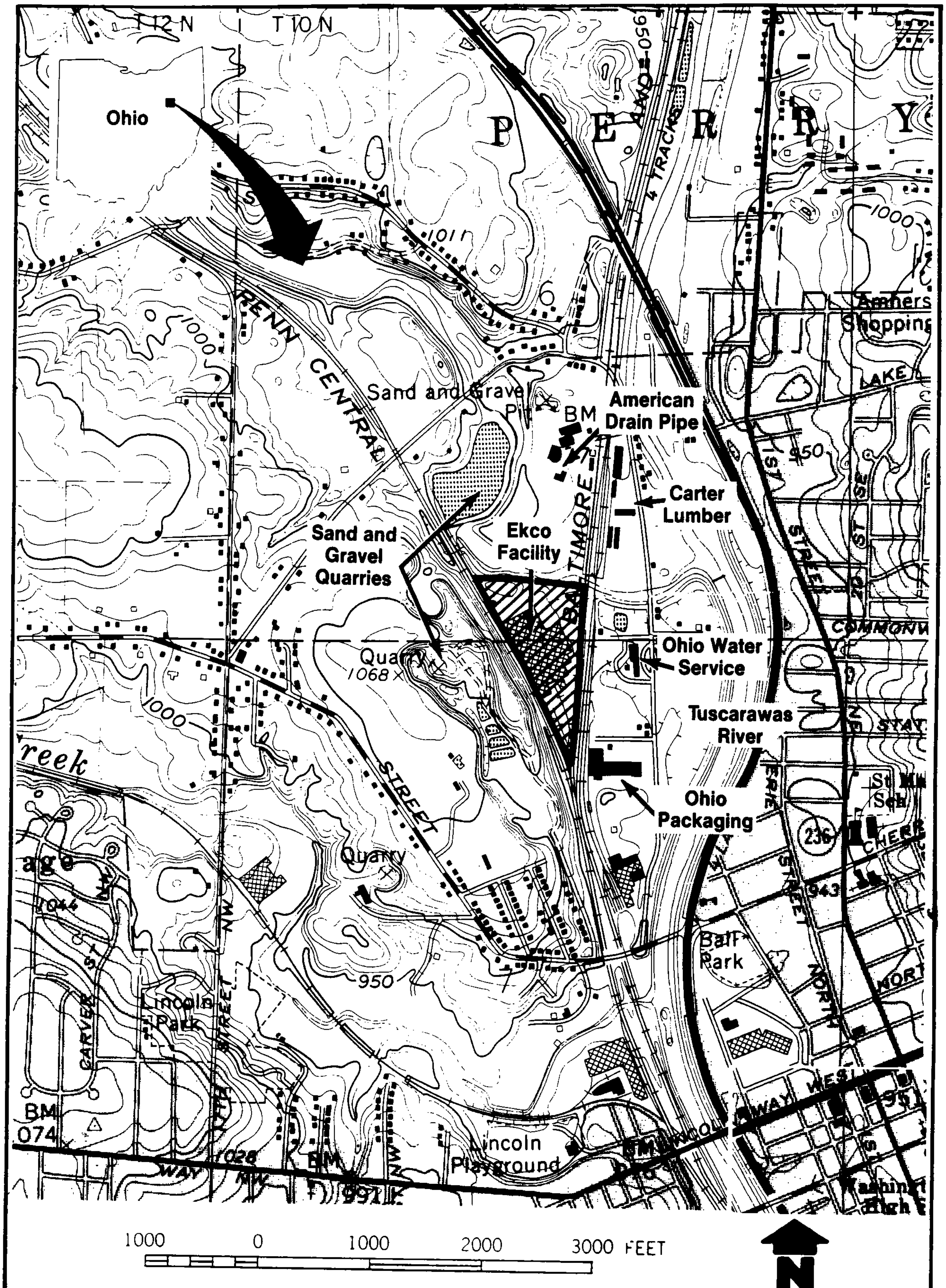

FIGURE 1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

1.3 SITE HISTORY

In 1945, the Massillon EKCO Housewares Facility was manufacturing aluminum and stainless steel cookware. By 1951, with the United States' involvement in the Korean Conflict, the plant was manufacturing 90mm and 105mm shell casings for the military. This increase in production necessitated the drilling of two production wells (W-1 and W-2) at the facility. In 1953, a sewer was constructed which carried the plant waste to a discharge point along Newman Creek. At approximately this same time, an surface impoundment was constructed along the northern property boundary adjacent to Newman Creek. Sludge from the waste treatment of the military production was discharged to the surface impoundment.

During 1954, the EKCO Housewares Facility began its electroplating operations. The primary function of these operations was to copper plate cookware manufactured at the facility. Solvents (primarily TCE or TCA) were used to clean the products prior to plating. However, TCA and TCE were never used at the same time. Sometime during the mid-1960's, EKCO stopped using TCE.

By 1967, the trends in the cookware manufacturing industry had changed, resulting in the installation of the porcelain and teflon coating units at the EKCO Facility. In 1969, with the development of new NPDES regulations and permit requirements, the surface impoundment was approved and permitted by the State of Ohio to discharge the waste products associated with plant activities. These waste products have included:

- Deionizers from copper plating operations (hydrochloric acid and sodium hydroxide).
- Washings and waste material from manufacturing porcelain-teflon coated aluminum cookware (aluminum frit, various coloring inorganics oxides, lead, cadmium, selenium, cobalt, and toluene).
- Alkaline washer fluids to clean aluminum cookware.

In July 1974, NPDES Permit No. C-3094BD was issued to the EKCO Housewares Facility (see Attachment A for the NPDES Permit). As the 1970's progressed, EKCO discontinued the manufacturing of aluminum and porcelain cookware and use of the lagoon ceased in 1977. By the end of 1978, all copper plating operations had ended and the principal products manufactured at the facility became pressed and coated non-stick bakeware.

Correspondence between the EKCO Housewares and the Ohio Environmental Protection Agency identified a solvent spill which had occurred between 1979 and 1980 as the only major recorded spill at the facility. The spill was in the vicinity of process water well W-10 which is located in Figure 2. Neither the exact location nor the extent of the spill was documented. However, W-10 is located in a sump and is covered with a grate flush with the plant floor which makes the well head vulnerable to floor drainage.

The surface impoundment was reinstated in 1980 under the same permit and received housing degreaser filter water until mid-1984. The surface impoundment was finally decommissioned in December 1985.

In March 1984, when the plant applied for a renewal of a NPDES Permit, the law required the analysis of on-site well water for volatile organics. The analysis indicated the presence of 1,1,1-trichloroethane (TCA) and trichloroethylene (TCE). This discovery resulted in subsequent investigations at the EKCO Housewares Plant. These investigative activities are described in Section 1.4 of this report.

EKCO Housewares, Inc. continues to manufacture pressed and coated non-stick bakeware at the Massillon facility. A silicon-based compound is presently used to coat the bakeware to create the non-stick surface.

1.4 PREVIOUS INVESTIGATIVE ACTIVITIES

In 1984, with the discovery of TCA and TCE in the ground water beneath the plant, EKCO Housewares, Inc. initiated a number of activities to investigate the problem. During the months of September and October 1984, seven test holes were drilled by Ohio Drilling, Inc. at the facility. Four test holes (TH-1-84 through TH-4-84) were drilled into the overburden and the remaining three were drilled into bedrock. Soil and water samples were collected via packer tests from all locations and revealed varying levels of volatile organic compounds (VOCs). Two of the shallow test holes, TH-1-84 and TH-2-84 were completed as 1 1/4-inch piezometers (P-1-84 and P-2-84, respectively), while the remaining two were plugged. All three of the bedrock test holes were completed as 6-inch bedrock wells (R-1 through R-3) with dedicated pumps. An additional bedrock well (R-4) was installed in July 1985 along the eastern property boundary. No contaminants were found in samples collected from this well. Approximate locations of the test holes and the R-wells can be seen on Figure 3. Attachment B contains well construction summary details for wells P-1-84, P-2 -84 and R-1 through R-4.

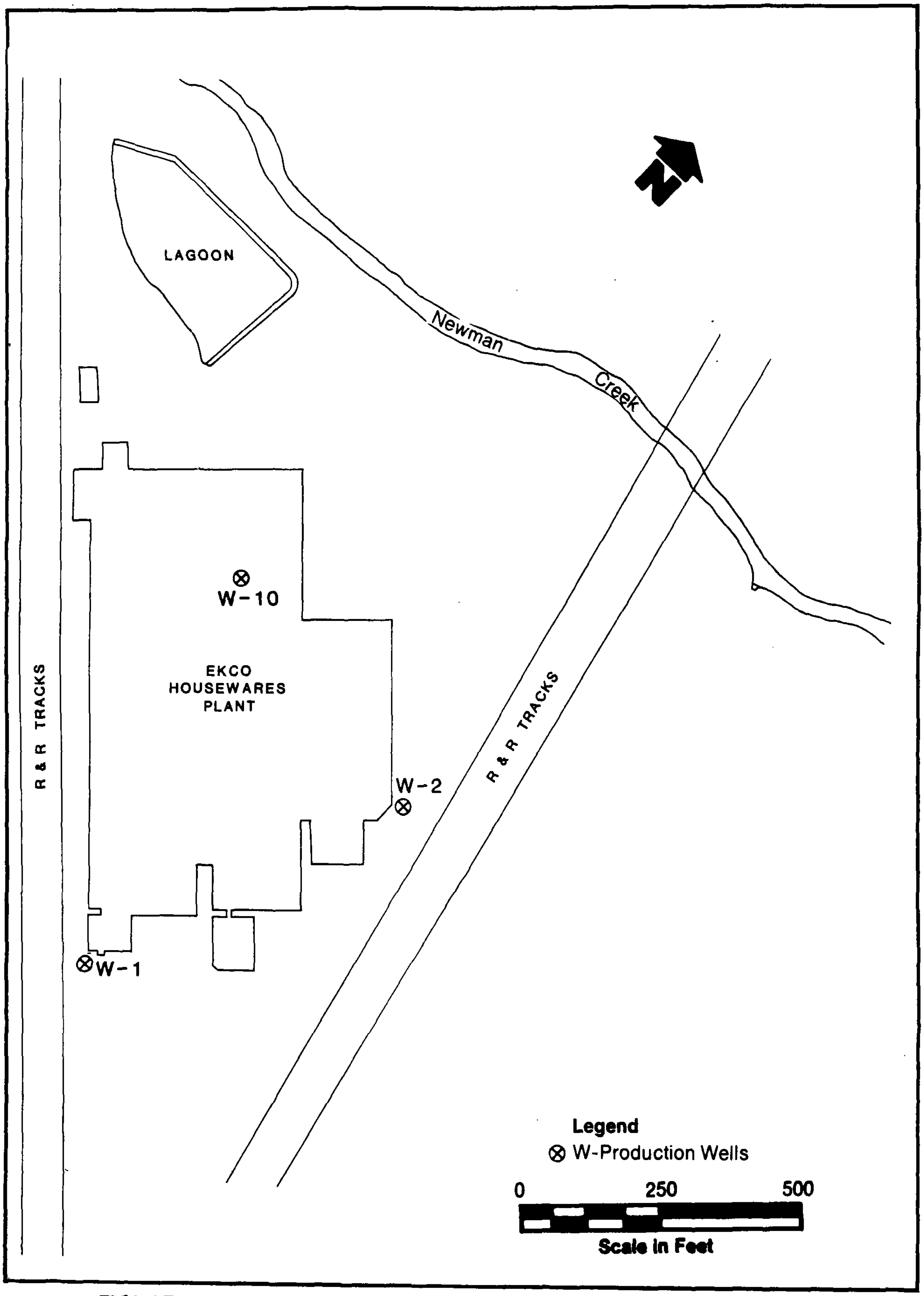

FIGURE 2 SITE DIAGRAM SHOWING LOCATIONS OF PRODUCTION WELLS EKCO HOUSEWARES, INC., MASSILLON, OHIO

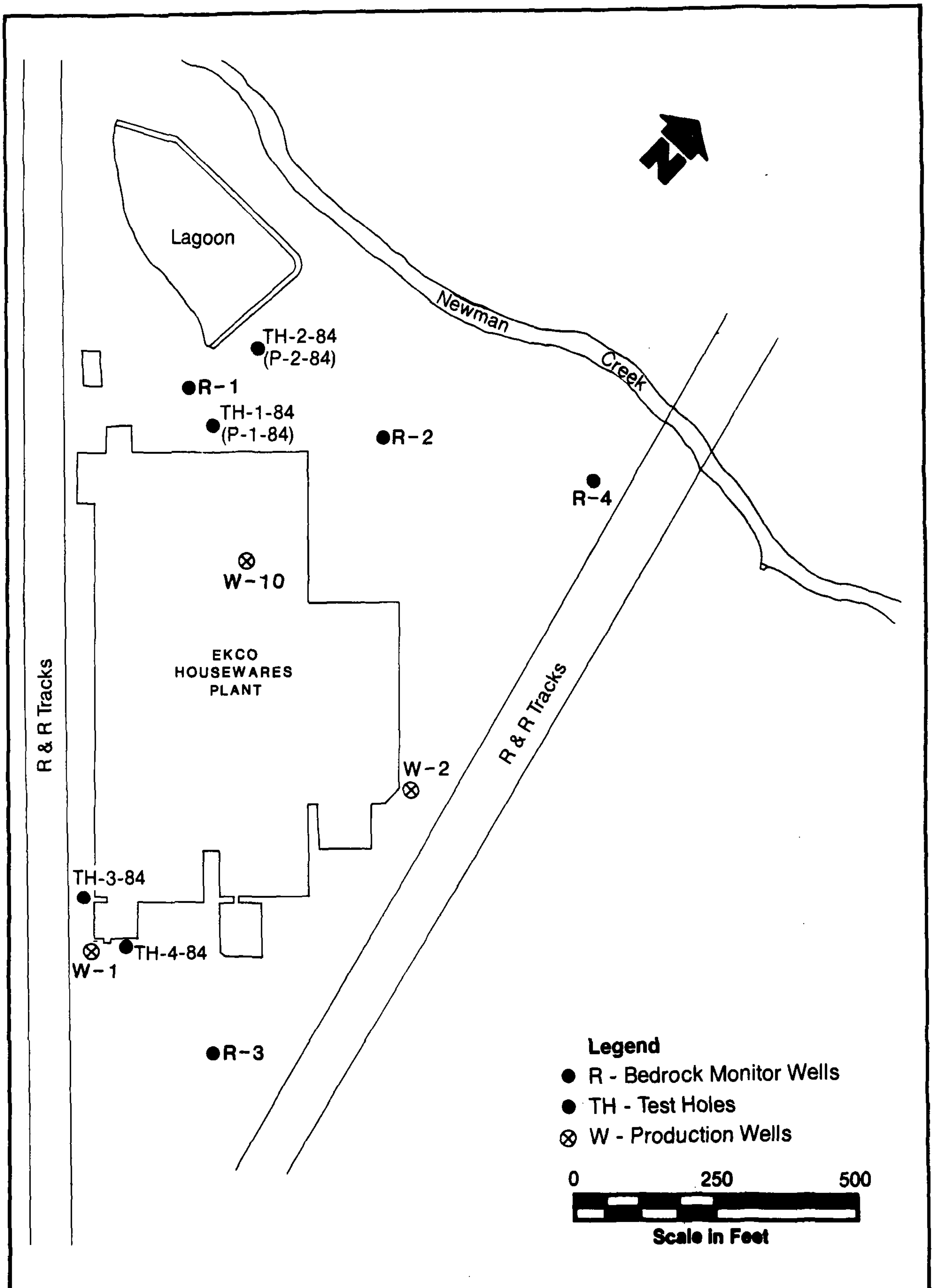

FIGURE 3 LOCATION OF ON-SITE TEST HOLES AND BEDROCK MONITOR WELLS EKCO HOUSEWARES, INC., MASSILLON, OHIO

Since the then out-of-service process well W-10 was centrally located on the ECKO Property, it was decided that a pump and treat program to control VOC's would be initiated at the facility utilizing this well. This action could prevent the off-site migration of the VOC's and reduce the VOC's level in the ground water beneath the site. With the concurrence of the Ohio EPA, an on-site air stripper was installed by Ohio Drilling, Inc. in February 1985.

The waste stream was diverted from the surface impoundment in December 1985. The surface impoundment (lagoon) was permanently taken out-of-service.

On June 17, 1986, the consulting firm Floyd Brown Associates, Limited (FBA), contracted by ECKO Housewares, Inc., developed a preliminary closure plan for the lagoon. The closure plan led to the Phase I screening investigation of the lagoon. Phase I involved drilling 12 soil borings at the following locations: 1) 4 borings (12 feet deep) were drilled through the bottom of the lagoon (borings A through D); 2) 4 borings (12 feet deep) were drilled at downgradient locations from the lagoon (borings E through H); and 3) 4 borings (3 feet deep) were drilled in presumably background locations (borings I through L). Figure 4 indicates the approximate locations of the Phase I soil borings. Samples from each group of soil borings were composited according to depth. The results indicate cadmium, chromium and lead within the lagoon and in the downgradient locations (see Tables 1 through 3). No VOC's were detected in any of the composited samples.

The Phase I investigation led to a more intensive Phase II soil boring program conducted by FBA in January and February 1987. The program involved drilling 25 soil borings at the locations explained in Table 4 and shown in Figure 5. Four of these soil borings which were located downgradient of the lagoon were completed as 1-1/2 inch PVC wells (D-1-27, D-2-30, D-3-17, D-4-30) and retained as monitoring points for the lagoon (see Attachment C for construction details). One hundred and fifty three (153) samples were collected from the soil borings and were analyzed for cadmium, chromium and lead. Only samples from D-2-30 and D-4-30 were analyzed for VOC's. Results from these analyses are presented in Tables 5 and 6.

In July 1987, Roy F. Weston, Inc. (WESTON) was contracted to begin development for a final closure program for the lagoon and to develop a ground water quality assessment program for the entire ECKO facility.

WESTON
MANAGERS DESIGNERS CONSULTANTS

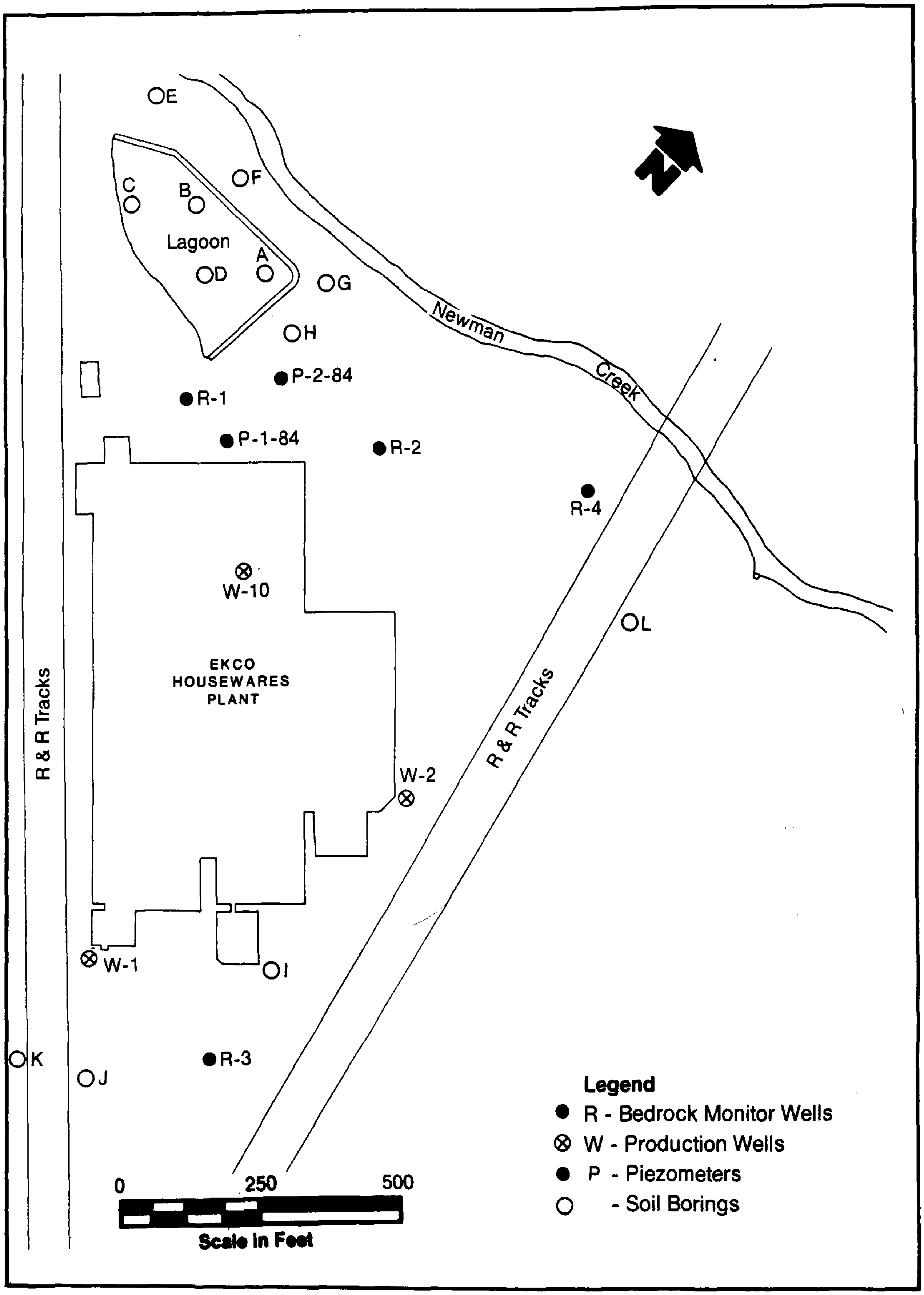

FIGURE 4 LOCATIONS OF FLOYD BROWN ASSOCIATES PHASE I SOIL BORINGS EKCO HOUSEWARES, INC., MASSILLON, OHIO

TABLE 1

Results of Composited (by depth) Lagoon Soil Boring Samples
FBA Phase I Soil Boring Program*

	Lagoon Composite Soils (Stations A through D)+							
Interval	0-1 Ft	1-2 Ft	2-3 Ft	3-4 Ft	6 Ft	8 Ft	10 Ft	12 Ft
Arsenic, mg/kg	13	12	12	21	9	10	11	13
Barium, mg/kg	600	130	77	140	58	42	120	42
Cadmium, mg/kg	450	4	<0.9	1.3	0.7	0.9	27	0.7
Chromium, mg/kg	230	130	35	120	9	7	14	10
Copper, mg/kg	880	400	93	47	20	12	230	15
Lead, mg/kg	2,430	1,670	12	17	18	8	190	13
Nickel, mg/kg	55	28	12	29	23	23	23	38
Selenium, mg/kg	3	<3	<4	<5	<3	<2.4	<4	<3
Zinc, mg/kg	830	1,370	70	500	120	170	200	73
Cyanide, mg/kg	0.3	0.4	0.6	1.6	0.4	0.2	0.2	0.2

*Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 4 November 1986.

+Locations found on Figure 4

TABLE 2

Results of Composited (by depth) Downgradient Soil Boring Samples
FBA Phase I Soil Boring Program*

Interval	0-1 Ft	1-2 Ft	2-3 Ft	3-4 Ft	6 Ft	8 Ft	10 Ft	12 Ft
	Downgradient Composite Soil Samples (Stations E through H)+							
Arsenic, mg/kg	13	14	7	9	6	25	14	17
Barium, mg/kg	72	99	47	69	58	18	58	17
Cadmium, mg/kg	10	3	0.7	0.7	<0.9	<0.7	<0.6	<0.6
Chromium, mg/kg	13	8	5	7	19	9	9	9
Copper, mg/kg	42	15	8	23	5	18	16	12
Lead, mg/kg	57	15	6	12	8	20	15	20
Nickel, mg/kg	28	24	30	16	6	26	16	22
Selenium, mg/kg	<2	<6	<3	<3	<3	<3	<2	<2
Zinc, mg/kg	65	86	56	89	18	91	52	65
Cyanide, mg/kg	0.2	0.4	0.1	0.1	1.8	<0.1	0.1	0.3

*Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 4 November 1986.

+Locations found on Figure 4

1040E

TABLE 3

Results of Background Soil Samples
FBA Phase I Soil Boring Program*

Boring Interval	I (0-1.5)	I (1.5-3.0)	J (0-1.5)	J (1.5-3.0)	K (0-1.5)	K (1.5-3.0)	L (0-1.5)	L (1.5-3.0)
	Background Soil Samples (Stations I through L)+							
Arsenic, mg/kg	15	18	2	6	10	10	11	5
Barium, mg/kg	350	51	45	26	70	14	110	72
Cadmium, mg/kg	<0.9	<1.0	<0.8	<0.8	2	<0.9	14	<0.6
Chromium, mg/kg	10	7	6	2	5	6	54	7
Copper, mg/kg	18	13	16	7	17	52	54	34
Lead, mg/kg	20	7	9	8	11	28	93	98
Nickel, mg/kg	14	230	35	23	19	72	24	32
Selenium, mg/kg	<4	<4	<3	<3	<3	<4	<4	<2
Zinc, mg/kg	32	54	65	23	64	32	180	100

*Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 4 November 1986.

+Locations found on Figure 4

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TABLE 4

LOCATION AND DEPTH OF FLOYD BROWN ASSOCIATES
PHASE II SOIL BORINGS

Type	Number	Depth	Location
Soil Borings	19	12 ft. each	Lagoon
Soil Borings (converted to 1 1/2-inch monitor wells)	4	1 @ 27 ft. 2 @ 30 ft. 1 @ 17 ft.	Downgradient of Lagoon
Soil Borings	2	1 @ 15 ft. 1 @ 8 ft.	Background
	25		

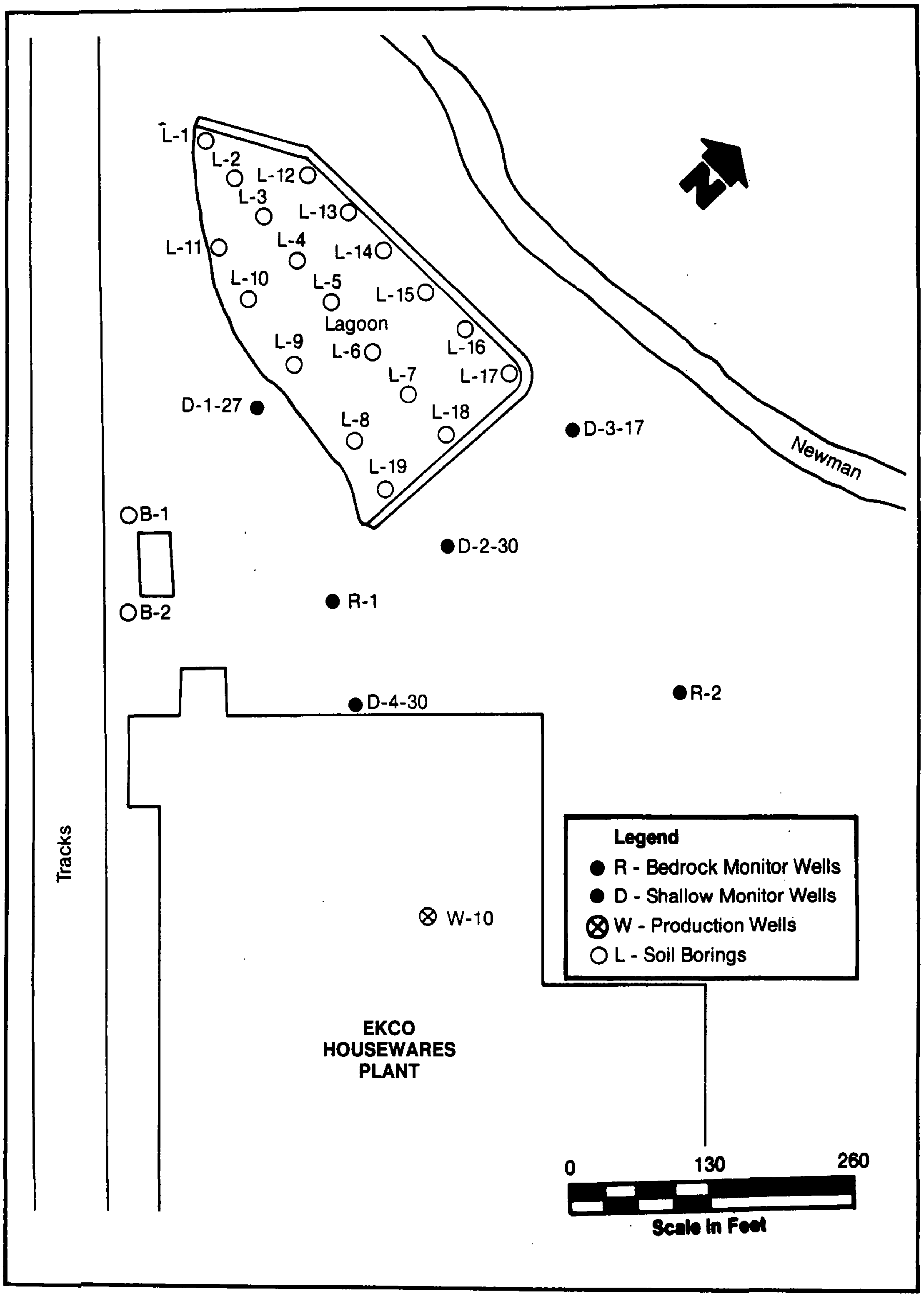

FIGURE 5 LOCATIONS OF FLOYD BROWN ASSOCIATES PHASE II SOIL BORINGS EKCO HOUSEWARES, INC., MASSILLON, OHIO

TABLE 5

RESULTS OF CADMIUM, CHROMIUM AND LEAD ANALYSES IN 153 SOIL SAMPLES

SOIL LOC.	TOTAL SOLID	CADMIUM MG/KG	CHROMIUM MG/KG	LEAD MG/KG
L-1-1	71	20	45	170
L-1-2	76.8	2	6	360
L-1-3	76.4	1	19	980
L-1-4	75.3	0.5	4	30
L-1-5	58.1	20	16	170
L-1-6	73	0.4	<0.80	11
L-1-7	80	2	3	30
L-1-8	66.1	0.5	<0.90	9
L-1-9	86	<0.30	<0.60	10
L-1-10	94	0.47	<0.90	7
L-2-1	63.9	180	130	940
L-2-2	74.4	2	10	400
L-2-3	73.1	<0.60	4	20
L-2-4	80.5	0.4	4	13
L-2-5	75.7	0.5	4	11
L-2-6	73.3	0.5	4	8
L-2-7	81.5	0.4	5	15
L-2-8	84.5	<0.50	2	8
L-2-9	88	0.5	2	5
L-2-10	88.6	<0.40	6	13
L-3-1	69.6	360	230	1200
L-3-2	80.6	<0.50	3	6
L-3-3	81.7	<0.50	4	6
L-3-4	83.9	0.5	2	3
L-3-5	85.7	0.4	2	4
L-3-6	87.6	<0.40	2	8
L-3-7	89.8	<0.40	1	10
L-3-8	85.4	<0.30	2	<1
L-4-1	40.7	1700	790	2800
L-4-2	75.4	0.6	6	13
L-4-3	77.6	0.8	6	8
L-4-4	77.3	<0.50	9	6
L-4-5	71.6	180	70	500
L-4-6	79	<0.30	5	6
L-4-7	74.9	0.4	6	12
L-4-8	87.8	<0.50	3	7
L-4-9	82	<0.20	2	3
L-4-10	85.3	<0.30	2	4
L-4-11	84.3	<0.40	5	3

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

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TABLE 5(CONTINUED)

RESULTS OF CADMIUM, CHROMIUM AND LEAD ANALYSES IN 153 SOIL SAMPLES

SOIL LOC.	TOTAL SOLID	CADMIUM MG/KG	CHROMIUM MG/KG	LEAD MG/KG
L-5-1	51.4	1100	500	2400
L-5-2	79.8	2	8	70
L-5-3	72.9	58	12	230
L-5-4	73	0.5	6	19
L-5-5	56.4	2	8	27
L-5-6	50.2	1	13	50
L-5-7	48.4	80	50	380
L-5-8	90.9	1	5	30
L-5-9	91.2	0.5	4	15
L-5-10	87.3	1	3	17
L-5-11	88.7	1	3	13
L-6-1	80.3	660	120	1700
L-6-2	66.3	4	7	55
L-6-3	66.5	10	20	80
L-6-4	50	2	18	60
L-6-5	74.3	3	11	50
L-6-6	91.9	1	4	30
L-6-7	90	4	4	30
L-6-8	97	0.5	3	8
L-6-9	88.9	0.4	2	5
L-6-10	86.2	0.5	2	10
L-7-1	69.5	600	290	2800
L-7-2	81.7	1	60	560
L-7-3	71.7	3	110	20
L-7-4	71.7	50	80	430
L-7-5	81	1	1	9
L-7-6	73.6	4	10	40
L-7-7	78.9	10	20	110
L-7-8	81.7	23	40	250
L-7-9	88.2	1	3	10
L-7-10	89.4	0.4	<1	6
L-7-11	90.5	1	4	9
L-7-12	91.3	0.5	<1	6
L-8-1	68.5	30	290	1400
L-8-2	65.9	7	60	85
L-8-3	63.7	2	130	40
L-8-4	72.6	3	90	180
L-8-5	74.7	2	40	40

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

TABLE 5(CONTINUED)

RESULTS OF CADMIUM, CHROMIUM AND LEAD ANALYSES
IN 153 SOIL SAMPLES

SOIL LOC.	TOTAL SOLID	CADMIUM MG/KG	CHROMIUM MG/KG	LEAD MG/KG
L-8-6	67.1	2	6	60
L-8-7	89.4	1	2	20
L-8-8	59.9	1	<1	12
L-8-9	66.2	<1	3	7
L-8-10	86.2	1	3	7
L-8A	26.9	8400	510	13800
L-9-1	75.4	12	170	940
L-9-2	75.3	4	2	20
L-9-3	74.3	2	6	14
L-9-4	63	3	3	20
L-9-5	51.2	4	2	20
L-9-6	40.7	8	4	25
L-9-7	88.5	<0.4	3	5
L-9-8	91.2	<0.5	2	3
L-9-9	90.8	<0.5	2	6
L-9-10	86.6	<0.5	2	2
L-9-11	88.2	2	3	7
L-9-12	88.4	0.4	3	6
L-10-1	71.9	90	80	740
L-10-2	80	4	9	780
L-10-3	69	4	1200	70
L-10-4	71.1	<0.7	8	5
L-10-5	78.7	0.8	5	130
L-10-6	88.5	2	5	30
L-10-7	91.1	0.5	3	4
L-10-8	85.8	<0.5	2	2
L-10-9	90.4	0.4	5	6
L-10-10	87.9	0.8	5	6
L-10-11	83.4	0.5	5	3
L-11-1	56.9	300	280	1100
L-11-2	76	1	26	30
L-11-3	77	0.6	52	20
L-11-4	80.7	0.6	7	4
L-11-5	85.7	<0.5	2	2
L-11-6	83.8	0.4	3	64
L-11-7	88.6	<0.5	4	7
L-11-8	88.9	0.5	3	6
L-11-9	85	0.6	3	7

Referenced from Floyd Brown Associates Closure Plan Presentation,
Memorandum Draft, 13 March 1987.

TABLE 5(CONTINUED)

RESULTS OF CADMIUM, CHROMIUM AND LEAD ANALYSES IN 153 SOIL SAMPLES

SOIL LOC.	TOTAL SOLID	CADMIUM MG/KG	CHROMIUM MG/KG	LEAD MG/KG
B-1-1	88.1	2	6	20
B-1-2	86.6	0.5	5	18
B-1-3	87	1	6	67
B-1-4	84	0.6	3	5
B-1-5	84.1	0.6	3	27
B-1-6	88.3	0.6	3	4
B-1-7	89.6	0.5	5	8
B-1-8	88.9	0.5	8	5
B-1-9	91	0.6	9	6
B-1-10	93.9	0.5	8	5
B-2-1	85.5	4	25	600
B-2-2	88.4	0.5	6	32
B-2-3	81.8	0.6	13	21
B-2-4	87.6	0.6	6	24
B-2-5	88	0.5	8	3
D-1-1	83.4	33	300	200
D-1-2	82.7	0.5	5	11
D-1-3	80.2	0.5	8	11
D-1-4	77.9	1	13	13
D-1-5	85.6	0.5	5	19
D-1-6	80.4	0.6	8	33
D-1-7	73.4	0.7	9	26
D-2-1	85.5	110	92	490
D-2-2	79.9	1600	340	4740
D-2-3	81.7	1300	210	2950
D-2-4	84.9	93	130	190
D-2-5	80.5	830	180	1570
D-2-6	90	1	24	400
D-2-7	82.2	0.5	22	290
D-2-8	80.7	0.8	7	420
D-2-9	76.8	1	34	480
D-2-10	76	0.6	9	80
D-2-11	79.2	0.6	6	10
D-2-12	79.7	0.5	5	8
D-3-1	86.5	0.6	6	16
D-3-2	89.5	0.5	5	13
D-3-3	89.4	0.6	7	13
D-3-4	81.5	0.6	5	5

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

TABLE 6

RESULTS OF VOLATILE ORGANIC ANALYSES IN D-2-30 AND D-4-30

FBA - Ekco
Priority Pollutant Volatile Fraction

	0-1'	1'-2'	2'-3'	3'-4'
ATEC SAMPLE NO.	10132	10133	10134	10135
CLIENT SAMPLE NO.	D-2-1	D-2-2	D-2-3	D-2-4
DATE RECEIVED	01/21/87	01/21/87	01/21/87	01/21/87
Acrolein	< 1.0	< 1.0	< 1.0	< 1.0
Acrylonitrile	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	<0.03	<0.03	<0.03	<0.03
Bromoform	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07	<0.07	<0.07
Chlorobenzene	<0.03	<0.03	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Chloroethane	< 1.0	< 1.0	< 1.0	< 1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07	<0.07	<0.07
Chloroform	<0.07	<0.07	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Dichlorodifluoromethane	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03	<0.03	<0.03
Methyl Bromide	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Chloride	< 1.0	< 1.0	< 1.0	< 1.0
Methylene Chloride	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03	<0.03	<0.03
Toluene	<0.03	<0.03	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,1,1-Trichloroethane	<0.07	<0.07	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07	<0.07	<0.07
Trichloroethene	0.04	0.07	0.11	0.15
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50
Vinyl Chloride	< 1.0	< 1.0	< 1.0	< 1.0
Total Xylenes	<0.03	<0.03	<0.03	<0.03

All results are reported as mg/kg

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

TABLE 6(CONTINUED)

RESULTS OF VOLATILE ORGANIC ANALYSES IN D-2-30 AND D-4-30

FBA - Ekco

Priority Pollutant Volatile Fraction	8-10'	13-14'
ATEC SAMPLE NO.	10138	10141
CLIENT SAMPLE NO.	D-2-7	D-2-10
DATE RECEIVED	01/21/87	01/21/87
Acrolein	< 1.0	< 1.0
Acrylonitrile	< 1.0	< 1.0
Benzene	<0.03	<0.03
Bromoform	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07
Chlorobenzene	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07
Chloroethane	< 1.0	< 1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07
Chloroform	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07
Dichlorodifluoromethane	< 1.0	< 1.0
1,1-Dichloroethane	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03
Methyl Bromide	< 1.0	< 1.0
Methyl Chloride	< 1.0	< 1.0
Methylene Chloride	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03
Toluene	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07
1,1,1-Trichloroethane	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07
Trichloroethene	0.39	0.06
Trichlorofluoromethane	<0.50	<0.50
Vinyl Chloride	< 1.0	< 1.0
Total Xylenes	<0.03	<0.03

All results are reported as mg/kg

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

TABLE 6(CONTINUED)

RESULTS OF VOLATILE ORGANIC ANALYSES IN D-2-30 AND D-4-30

FBA - Ekco
Priority Pollutant Volatile Fraction
SW-846 Method 8240

	0.75-1.5	3.0-4.5	7.5-9.0	11.75-12.5
ATEC SAMPLE NO.	10364	10365	10366	10367
CLIENT SAMPLE NO.	D-4-2	D-4-5	D-4-8	D-4-12
DATE RECEIVED	02/18/87	02/18/87	02/18/87	02/18/87
Acrolein	< 1.0	< 1.0	< 1.0	< 1.0
Acrylonitrile	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	<0.03	<0.03	<0.03	<0.03
Bromoform	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07	<0.07	<0.07
Chlorobenzene	<0.03	<0.03	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Chloroethane	< 1.0	< 1.0	< 1.0	< 1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07	<0.07	<0.07
Chloroform	<0.07	<0.07	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07	<0.07	<0.07
Dichlorodifluoromethane	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03	<0.03	<0.03
Methyl Bromide	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Chloride	< 1.0	< 1.0	< 1.0	< 1.0
Methylene Chloride	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03	<0.03	<0.03
Toluene	<0.03	<0.03	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07	<0.07	<0.07
1,1,1-Trichloroethane	2.26	<0.07	<0.07	<0.07
1,1,2-Trichloroethane	<0.07	<0.07	<0.07	<0.07
Trichloroethene	5.30	0.26	1.48	0.08
Trichlorofluoromethane	<0.50	<0.50	<0.50	<0.50
Vinyl Chloride	< 1.0	< 1.0	< 1.0	< 1.0
Total Xylenes	<0.03	<0.03	<0.03	<0.03

All results are reported as mg/kg.

Referenced from Floyd Brown Associates Closure Plan Presentation, Memorandum Draft, 13 March 1987.

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TABLE 6(CONTINUED)

RESULTS OF VOLATILE ORGANIC ANALYSES IN D-2-30 AND D-4-30

FBA - Ekco
Priority Pollutant Volatile Fraction
SW-846 Method 8240

	15.5-17.0	19.25-20.0
ATEC SAMPLE NO.	13068	13069
CLIENT SAMPLE NO.	D-4-15	D-4-19
DATE RECEIVED	02/18/87	02/18/87
Acrolein	< 1.0	< 1.0
Acrylonitrile	< 1.0	< 1.0
Benzene	<0.03	<0.03
Bromoform	<0.05	<0.05
Carbon Tetrachloride	<0.07	<0.07
Chlorobenzene	<0.03	<0.03
Chlorodibromomethane	<0.07	<0.07
Chloroethane	< 1.0	< 1.0
2-Chloroethyl Vinyl Ether	<0.07	<0.07
Chloroform	<0.07	<0.07
Dichlorodibromomethane	<0.07	<0.07
Dichlorodifluoromethane	< 1.0	< 1.0
1,1-Dichloroethane	<0.07	<0.07
1,2-Dichloroethane	<0.07	<0.07
1,1-Dichloroethene	<0.07	<0.07
1,2-Dichloropropane	<0.07	<0.07
cis-1,3-Dichloropropene	<0.07	<0.07
trans-1,3-Dichloropropene	<0.07	<0.07
Ethyl Benzene	<0.03	<0.03
Methyl Bromide	< 1.0	< 1.0
Methyl Chloride	< 1.0	< 1.0
Methylene Chloride	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	<0.03	<0.03
Tetrachloroethene	<0.03	<0.03
Toluene	<0.03	<0.03
trans-1,2-Dichloroethene	<0.07	<0.07
1,1,1-Trichloroethane	0.16	<0.07
1,1,2-Trichloroethane	<0.07	<0.07
Trichloroethene	1.27	<0.03
Trichlorofluoromethane	<0.50	<0.50
Vinyl Chloride	< 1.0	< 1.0
Total Xylenes	<0.03	<0.03

All results are reported as mg/kg.

Referenced from Floyd Brown Associates Closure Plan Presentation,
Memorandum Draft, 13 March 1987.

1.5 PRESENT INVESTIGATIVE ACTIVITIES

In September 1987, WESTON conducted an assessment to collect baseline information and to determine the need for interim corrective measures. This included the following activities:

- Sampling of Ohio Water Service Well No. 4 and all on-site wells (except the out-of-service process water well W-2) to establish baseline data for each well and collecting well data (OVA readings, construction details, depth to water measurements, etc.).

- Surveying all on-site wells.

- Conducting a ground water utilization survey which included identifying and locating domestic, commercial and municipal wells within a one-mile radius of the site. The methods for conducting this survey are outlined in the Interim Measures Report, February 1988.

- Reviewing plant records and other available documents which included aerial photographs, tax maps and geologic references.

The results of this initial investigation are presented in the Interim Measures Report, February 1988. While no immediate threat to potable water supplies was identified, WESTON recommended that pumpage be increased, if practical, in order to enhance contaminant recovery and hydraulic control of ground water underlying the plant.

The results of the ground water sampling are presented in Tables 7 and 8. These analyses indicated the presences of VOC's in the ground water beneath the site.

The culmination of the Phase I investigation is contained within this work plan for the ground water quality assessment. This report outlines the tasks and the field activities necessary to properly investigate the potential point sources contamination and the RCRA closure of the lagoon. Information gathered during these activities will aid in the formulation of corrective actions at the EKCO Housewares Facility, Massillon, Ohio.

TABLE 7

RESULTS OF 3 SEPTEMBER 1987 OHIO WATER SERVICE COMPANY
WELL NO. 4 GROUND WATER SAMPLE
(ug/l)

	WELL #4	WELL #4 DUP	WELL #4 MATRIX SPIKE	WELL #4 MATRIX SPIKE DUP	FIELD BLANK	TRIP BLANK
Benzene	4.6	4.7	90%	97%	---	---
Chloroform	---	---	---	---	3.2	3.1
Tetrachloroethene	---	---	1.8	1.8	---	---
Trichlorofluoromethane	1.2	1.3	1.2	1.2	1.5	1.3
Vinyl Chloride	2.5	2.9	2.3	2.5	---	---

Notes:
--- = Analyzed, not detected

TABLE 8

RESULTS OF 23 SEPTEMBER 1987 PRODUCTION AND MONITORING WELL
SAMPLES AT THE EKCO SITE
(ug/l)

	BEDROCK WELLS								SHALLOW WELLS			
	R-1	R-2	R-3	R-4	R-5	W-1	W-10	W-10D*	D-1-2	D-2-30	D-3-17	D-4-30
Acetone		12						110				26
2-Butanone												95
Carbon Disulfide												1J
Carbon Tetrachloride												220
Chloroform												13
Chloromethane												2J
1,1-Dichloroethane	15		4J			130	180	160	4J	97	160	8400
1,2-Dichloroethane		75						5				100
1,1-Dichloroethene	6	11				16	160	110		5	3J	20000
Methylene Chloride	3JB	3JB	4JB	4JB	3JB	3JB	4JB	5B	3JB	3JB	3JB	19B
Toluene							1J	2J				
Trans-1,2-Dichloroethene	65	200				17	110	84	4J	100	54	210
1,1,1-Trichloroethane	84	41	2J			100	3800	4500	18	9	10	180000
Trichloroethene	270	1100	2J			140	1700	2100	75B	36	16	57000
1,1,2 Trichloroethane												130
Vinyl Chloride	19	45					7J			86	110	10

Notes:
* = Duplicate Sample
J = Estimated Value
B = Analyte Found in Blank and Sample

SECTION 2

ENVIRONMENTAL SETTING

2.1 GEOLOGY

2.1.1 Regional Geology

Most of Stark County, Ohio has been covered by at least two continental ice sheets resulting in variable surficial geologic conditions. The glaciers covered the land surface with a veneer of glacial drift deposits, which range from fine clay particles to huge boulders. The glacial drift thickness ranges from less than 25 feet to about 100 feet. In the areas of buried valleys however, this unconsolidated material can exceed 500 feet in thickness (Ohio Department of Natural Resources, 1972).

Melting ice from the receding glaciers produced large quantities of water carrying outwash material. This outwash material, deposited in broadly spread outwash plains and in restricted valleys in the form of kames, eskers and valley fill, is generally composed of well sorted, cross-bedded and horizontally layered sands and gravels.

Underlying these glacial drift and outwash deposits are sedimentary rocks of the Pennsylvanian, Mississippian, and Devonian geologic systems. These bedrock formations dip generally to the southeast at about 20 to 40 feet per mile and consist of sandstone and shale with some interbedded coal and occasional thin limestone units (Cross, 1959). Table 9 summarizes the generalized stratigraphic sequence for northeast Ohio. Figure 6 illustrates the surface geology, including a cross section, of Ohio.

2.1.2 Local Geology

The site directly overlies glacial outwash deposits of interbedded and interlensing sand, gravel and clay. These unconsolidated materials appear to thicken to the northeast with thicknesses ranging from 24 feet near the southwest corner of the plant to 92 feet at well R-4. Thick (greater than 250 feet) sand and gravel outwash deposits, comprising a deep buried valley, are present immediately east of the site.

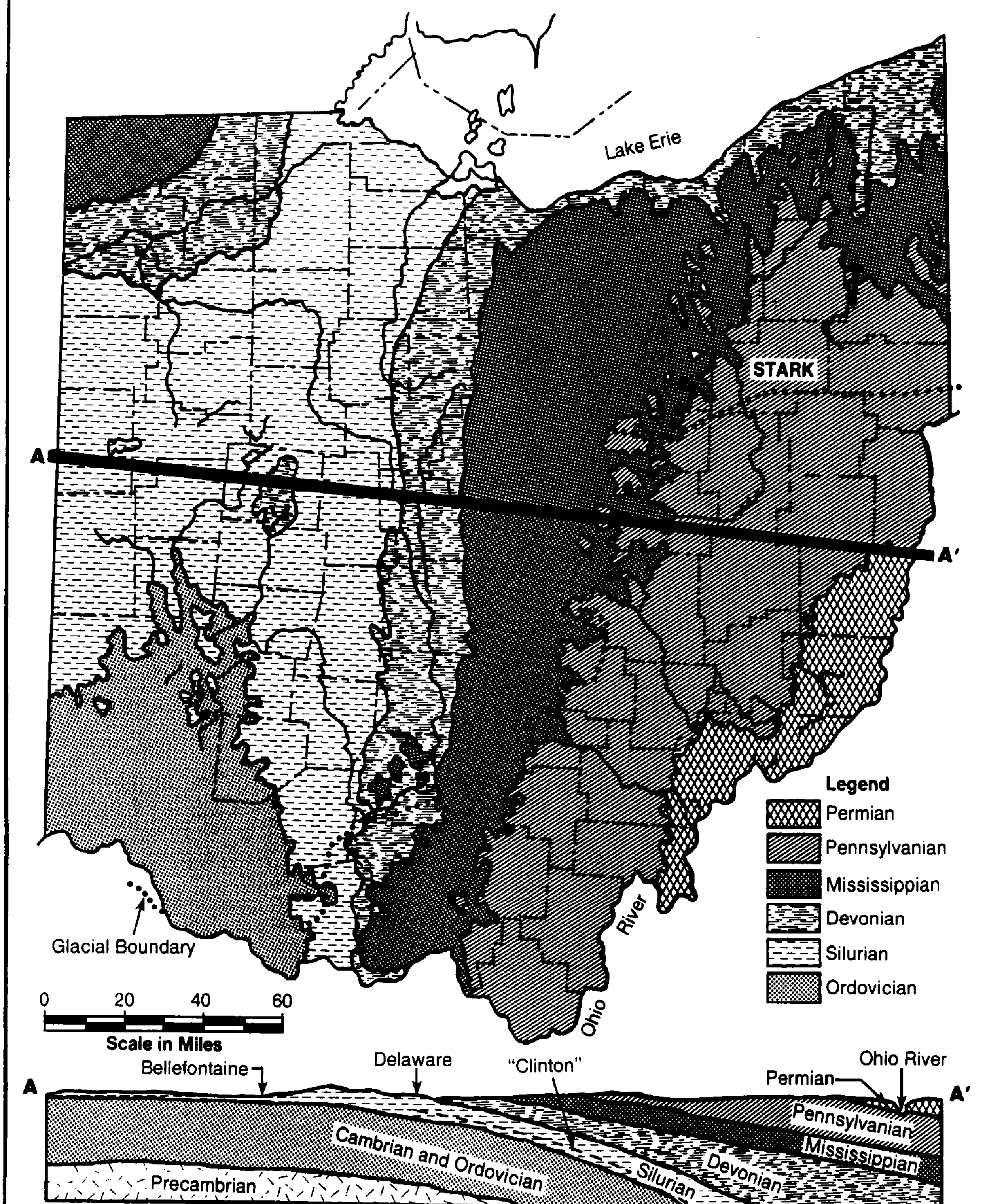
The bedrock beneath the site consists of interbedded sand-stone and shale belonging to the Pottsville group of

TABLE 9

GENERALIZED STRATIGRAPHIC SEQUENCE IN NORTH EAST OHIO

SYSTEM OR SERIES	GROUP OR FORMATION	CHARACTER OF MATERIAL	WATER-BEARING CHARACTERISTICS
Quaternary Recent		Clay, silt, and alluvium deposited on the flood plains of the principal valleys.	Generally a poor source of ground water, owing to limited thickness and absence of coarse materials.
Quaternary Pleistocene		Interbedded and interlensing layers of sand, gravel, and clay deposited in the buried valleys by glacial meltwaters.	Quantity of underground water available depends on character of material and source of recharge. Properly developed wells yield in excess of 1000 gallons per minute.
		Thick layers of silt and clay interbedded with relatively thin lenses of sand and gravel.	Drilled wells developed in the sand and gravel yield 5 to 15 gpm.
Pennsylvanian	Pottsville	Alternating layers of shale, sandstone, limestone, and coal.	Yields sufficient underground water for farm and domestic needs.
		Thin to thick, coarse-grained sandstone.	Domestic, farm and industrial supplies are readily available. Yields of as much as 500 gpm reported. However, regional yield seldom exceeds 15 gallons per minute.
Mississippian		Alternating layers of sandstone and shale.	Farm and domestic supplies are readily developed. If thick shale formations predominate, meager ground water supplies are developed.

SOURCE: (Schmidt, 1962)



(Source: Division of Geological Survey
Ohio Department of Natural Resources)

FIGURE 6 GEOLOGIC MAP AND CROSS SECTION OF NORTH EAST OHIO

Pennsylvanian age. The thickness of this formation is reported to be approximately 255 feet (Morningstar, 1922). Two cross sections were generated using the driller's stratigraphic logs for the site wells which were obtained in the Phase I plant record search. Sections A-A' and B-B' (lines shown on Figure 7) are illustrated in Figures 8 and 9, respectively. Both sections show that the outwash sediments thicken to the north and east.

2.2 HYDROLOGY

2.2.1 Regional Hydrology

The western portion of Stark County lies within the Middle Tuscarawas River Basin. The units capable of providing sufficient quantities of ground water to domestic, commercial and municipal wells underlying this basin include the unconsolidated deposits of sand and gravel and the consolidated layers of sandstone, shale, limestone and coal. Yields may range from less than 1 gallon per minute from clay and shale deposits to more than 1,000 gallons per minute from thick permeable sand and gravel deposits (Schmidt, 1962). The generalized stratigraphic table (Table 9) briefly describes the physical and water-producing characteristics of the units within the Tuscarawas River Basin. Figure 10 illustrates the availability and yield of ground water in the western portion of Stark County.

The outwash deposits beneath the flood plain of the Tuscarawas River have the greatest potential for the development of large ground water supplies in this basin. Meltwater from the receding glaciers followed the deep valley channel formed by the Tuscarawas River. As a result of overloading, the meltwater deposited thick layers (up to 285 feet (Schmidt, 1962)) of sand and gravel in the Massillon, Ohio area as shown in Figure 10. Since these deposits provide a reservoir for the ground water, yields from properly developed wells in this unit range from 500 to more than 3,000 gallons per minute. The majority of these wells are developed at depths less than 160 feet (Schmidt, 1962).

Many of the tributaries to the Tuscarawas River are also underlain by thick outwash valley deposits of predominantly clay interbedded with layers of fine sand and gravel. Portions of these tributary valleys are filled with as much as 270 feet of materials (Schmidt, 1962). But, because of the predominance of clay, the average yield of these deposits is less than 25 gallons per minute, and often, water wells are drilled through these unconsolidated deposits to the underlying bedrock.

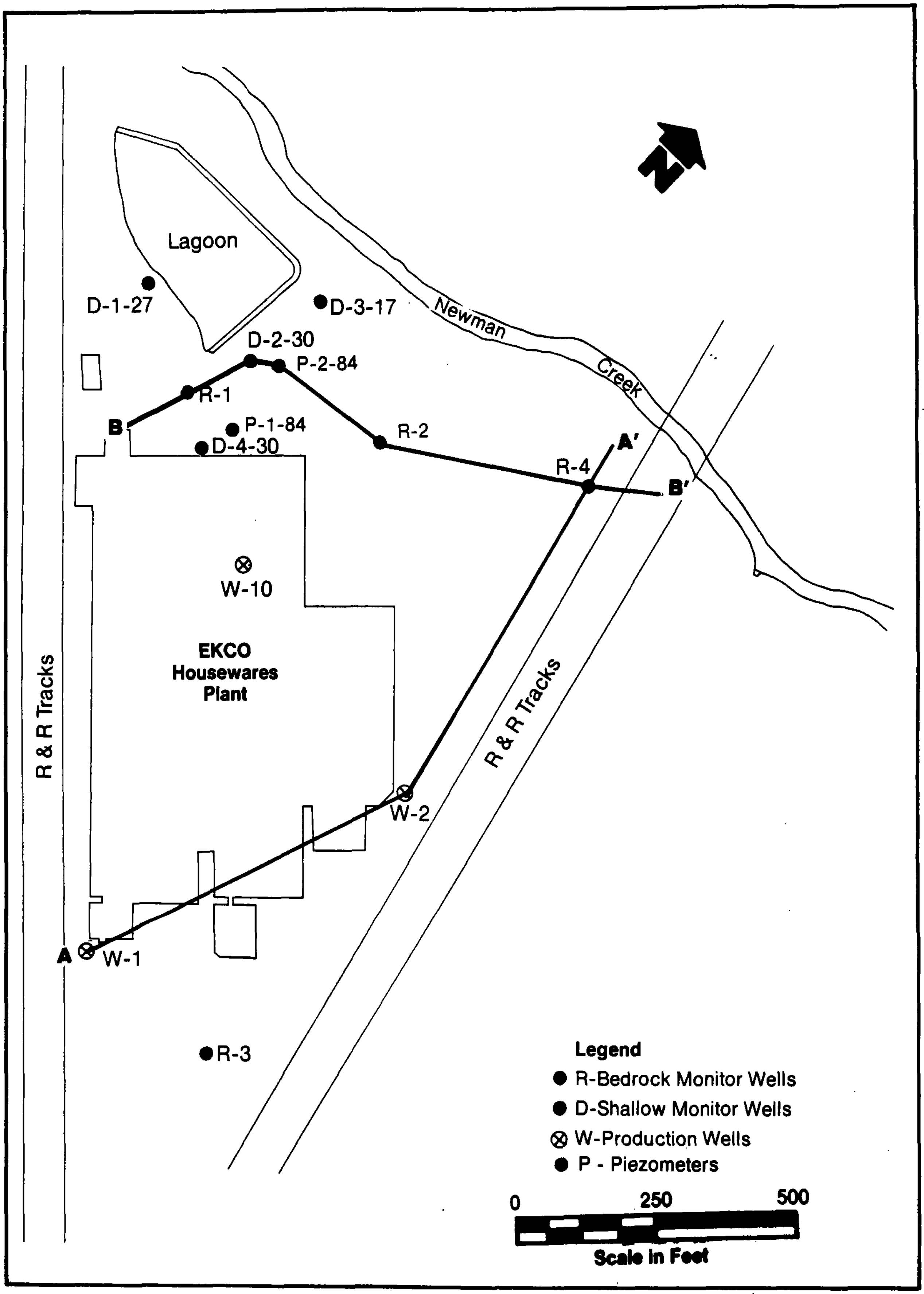


FIGURE 7 **LOCATIONS OF CROSS SECTIONS A-A′ AND B-B′**
EKCO HOUSEWARES, INC., MASSILLON, OHIO

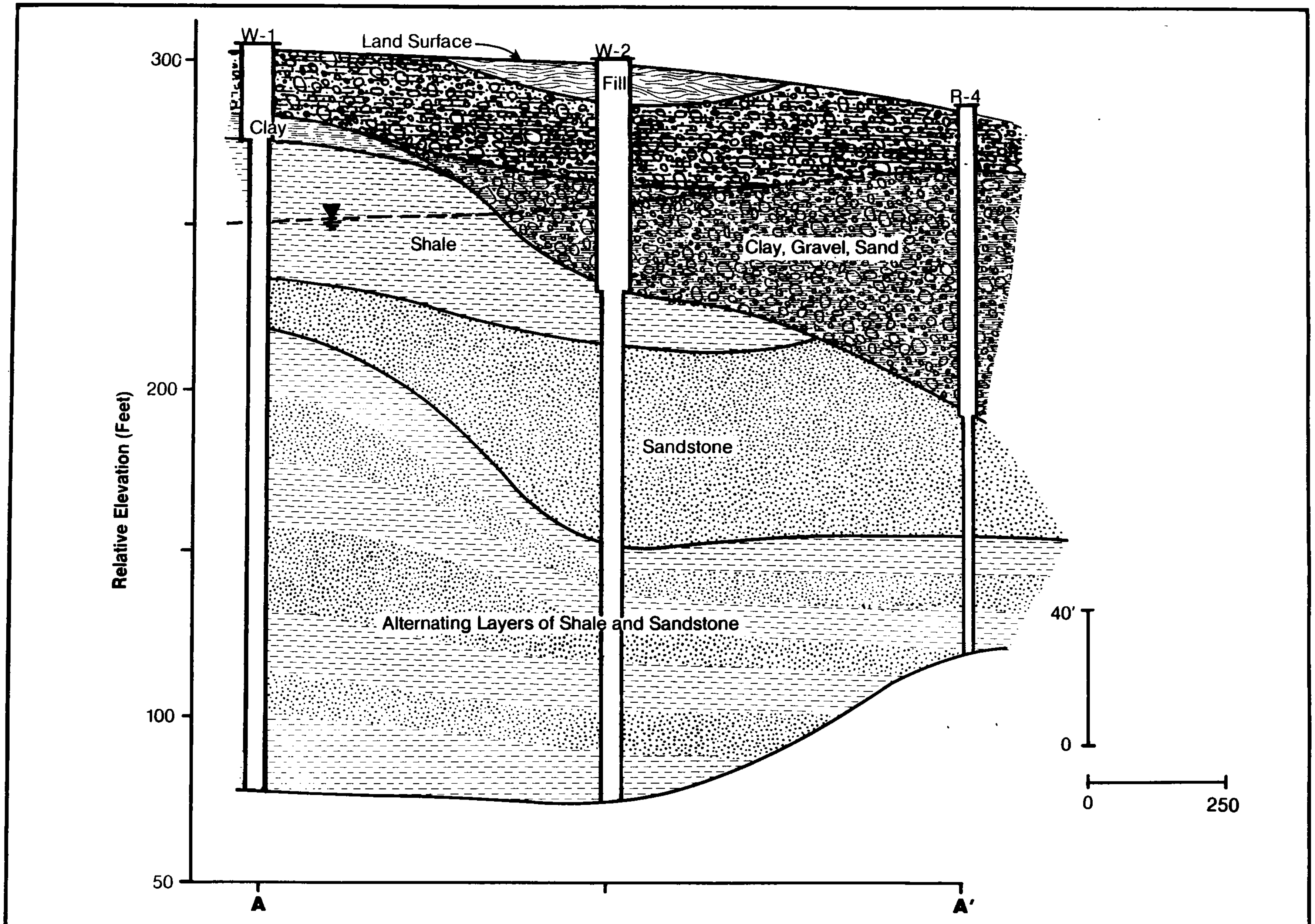


FIGURE 8 GEOLOGIC CROSS SECTION A-A'
EKCO HOUSEWARES, INC., MASSILLON, OHIO

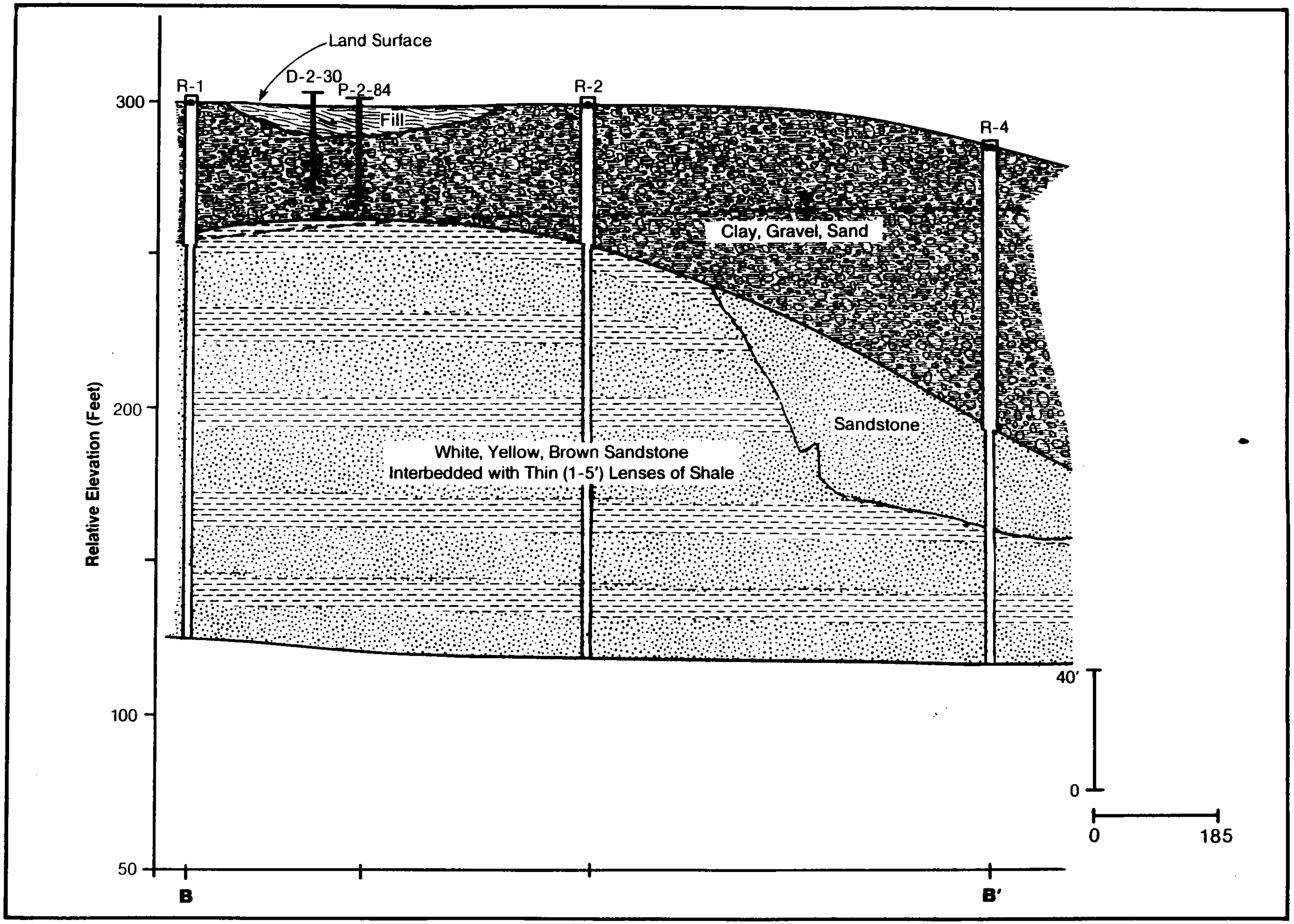
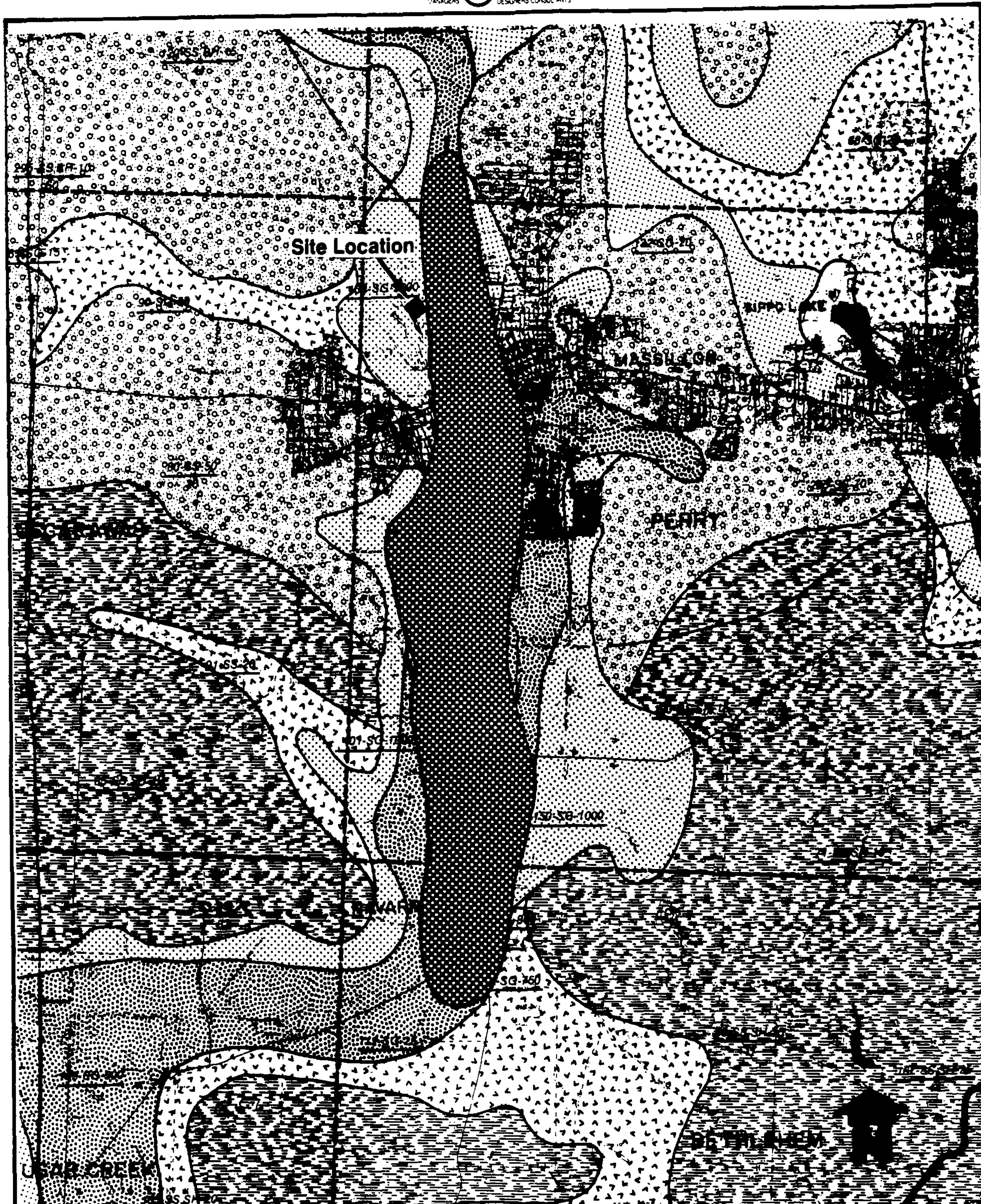


FIGURE 9 GEOLOGIC CROSS SECTION B-B'
EKCO HOUSEWARES, INC., MASSILLON, OHIO



Legend

- = Permeable Sand and Gravel Deposits in Deep Buried Valleys. Can Yield More Than 500 gpm.
- = Valley Fill Containing Sand and Gravel Deposits of Limited Thickness and Extent. Can Yield 10-30 gpm.
- = Permeable Sand and Gravel Deposits Not Traversed by Major Streams. Can Yield 100-500 gpm.
- = Interbedded and Interlensing Sand, Gravel, Silt and Clay. Can Yield 25-100 gpm.
- = Sandstones of the Pottsville Group. Can Yield 25-100 gpm.
- = Sandstones and Sandy Shales. Can Yield 10-30 gpm.

Scale in Miles

0 1 2 3 4

(Source: **Groundwater Resources of Stark County,** Alfred C. Walker, Ohio Department of Natural Resources.)

FIGURE 10 GROUNDWATER RESOURCES OF MASSILLON, OHIO

The bedrock beneath this basin consists of interbedded thin to thick layers of sandstone, shale, coal and occasional limestone units all belonging to the Pottsville group of Pennsylvanian age. Due to the change of physical characteristics within this formation, ground water wells range in depth from 46 feet to 500 feet. It has been reported that yields of ground water range from less than one to more than 500 gallons per minute (Schmidt, 1962). The average domestic well is 170 feet and yields about eight gallons per minute. Yields of commercial and municipal wells developed in the sandstone units of the lower Pottsville formation are reported to be as low as 25 to 100 gallons per minute (Walker, 1979).

2.2.2 Local Hydrology

The deep buried valley deposits of sand and gravel and the Pottsville sandstone are the principal aquifers utilized in the Massillon area. Within a one-mile radius of the site, approximately 50 domestic and 5 commercial wells (including site wells W-1, W-2 and W-10) are completed in the Pottsville sandstone and approximately 6 municipal wells tap the highly permeable sand and gravel deep buried valley deposits. Figure 11 locates the wells within a one-mile radius of the site. No information is available on the average depth of the domestic wells but depths of the commercial and municipal wells average approximately 225 and 150 feet, respectively.

Although the literature has reported ground water yields from individual wells installed in the Pottsville sandstone, of only 25 to 100 gallons per minute, the two on-site production wells collectively withdraw over 400 gallons per minute. Yields of over 2,000 gallons per minute have been obtained from the local municipal wells completed in sand and gravel outwash deposits located just east and northeast of the site.

The existing on-site monitoring wells are completed in both the Pottsville sandstone and in the unconsolidated tributary outwash deposits. The depth to ground water ranged from 8 to 26 feet below ground surface for the wells installed in the tributary outwash deposits while the ground water levels in the wells installed in the Pottsville sandstone ranged from 22 to 52 feet below ground surface. Adjusting for elevation, this represents a vertical head difference of

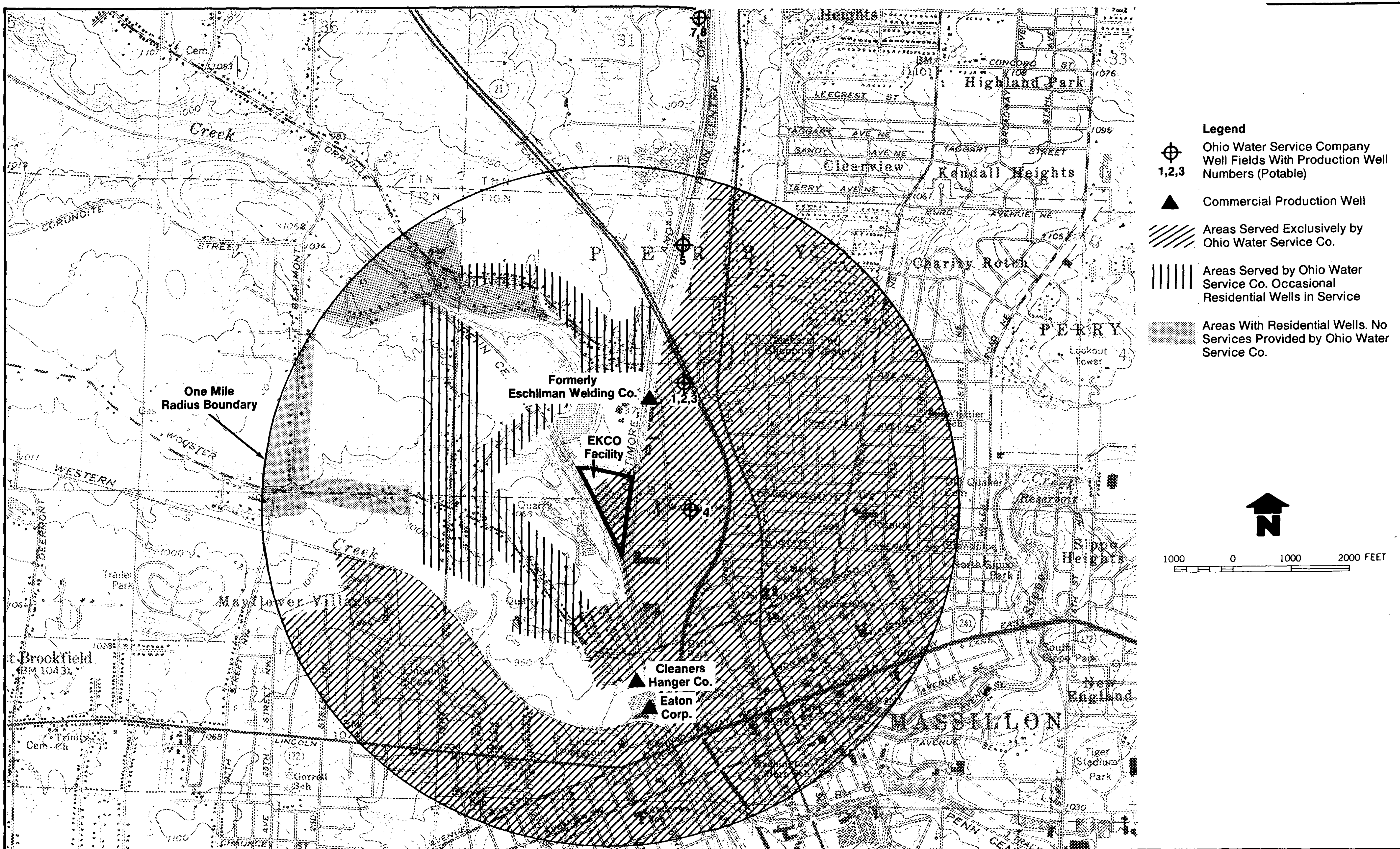


FIGURE 11 WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY

15 to 25 feet between the overburden and bedrock. During the month for which on-site data are available (September 1987), the water elevations have remained relatively constant, and only minor fluctuations have been observed as seen in Table 10.

The September 10, 1987 water level data were used to generate the water table map for the wells installed in the sandstone unit as shown in Figure 12. The ground water withdrawals from wells W-1 and W-10 are causing a cone of depression at the property center, thus obscuring the regional gradient.

Figure 13 shows that the shallower on-site wells (D-1-27, D-2-30, D-3-17 and D-4-30) have water levels which differ from those in the deeper wells. The ground water flow direction in the shallow water table zone appears to be the southeast, parallel to Newman Creek, and towards the Tuscarawas River.

TABLE 10

GROUND WATER ELEVATIONS (RELATIVE*) IN
ON-SITE PRODUCTION AND MONITORING WELLS (FEET)

WELL	WELL HEAD ELEVATION	4 SEPT 1987 DTW	4 SEPT 1987 ELEVATION	9 SEPT 1987 DTW	9 SEPT 1987 ELEVATION	22 SEPT 1987 DTW	22 SEPT 1987 ELEVATION
W-1	303.02	52.09	250.93	51.93	251.09	---	---
W-2	299.59	44.89	254.70	---	---	---	---
W-10	295.87	56.09	239.78	53.25	242.62	53.52	242.35
R-1	301.19	45.05	256.14	44.42	256.77	46.00	255.19
R-2	300.64	37.78	262.86	37.37	263.27	38.78	261.86
R-3	301.46	42.14	259.32	40.83	260.63	43.33	258.13
R-4	287.58	21.49	266.09	20.83	266.75	22.88	264.70
D-1-27	302.40	20.44	281.96	19.27	283.13	20.61	281.79
D-2-30	300.48	25.65	274.83	25.24	275.24	26.03	274.45
D-3-17	291.13	8.27	282.86	8.95	282.18	8.14	282.99
D-4-30	304.03	26.37	277.66	26.06	277.97	26.62	277.41
P-1-84	302.96	---	---	Dry	Dry to 281.25	---	---
P-2-84	300.15	---	---	24.88	275.27	---	---
Downstream		283.25	283.25	---	---	---	---

Notes:

DTW = Depth to water from top of casing
--- = Water level not taken
* = Relative to a bench mark with an assigned elevation of 300.00 feet

WESTON
MANAGERS
DESIGNERS/CONSULTANTS

WESTON
MANAGERS DESIGNERS CONSULTANTS

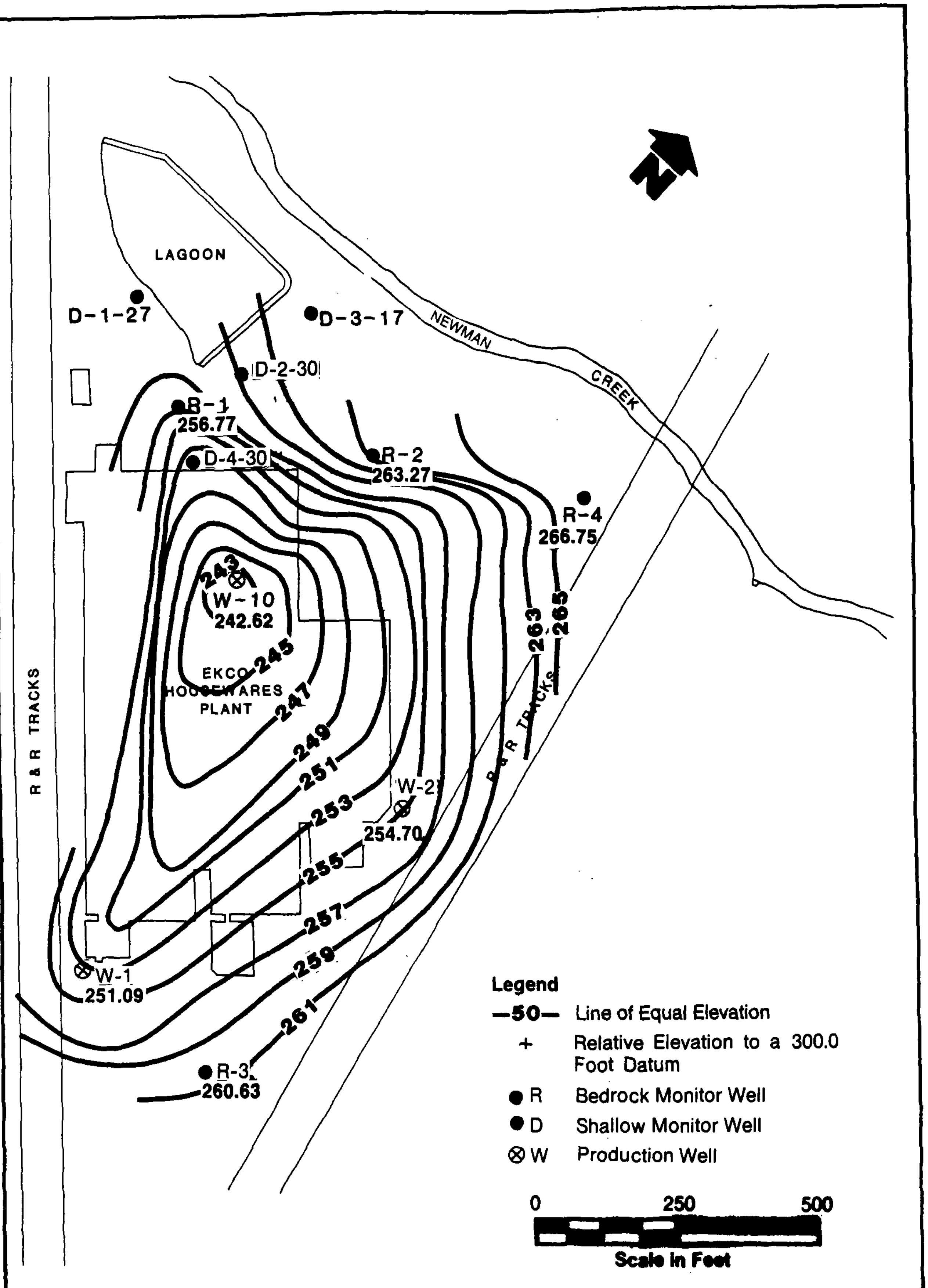


FIGURE 12 CONTOUR OF BEDROCK GROUNDWATER ELEVATIONS +
EKCO HOUSEWARES, INC., MASSILLON, OHIO

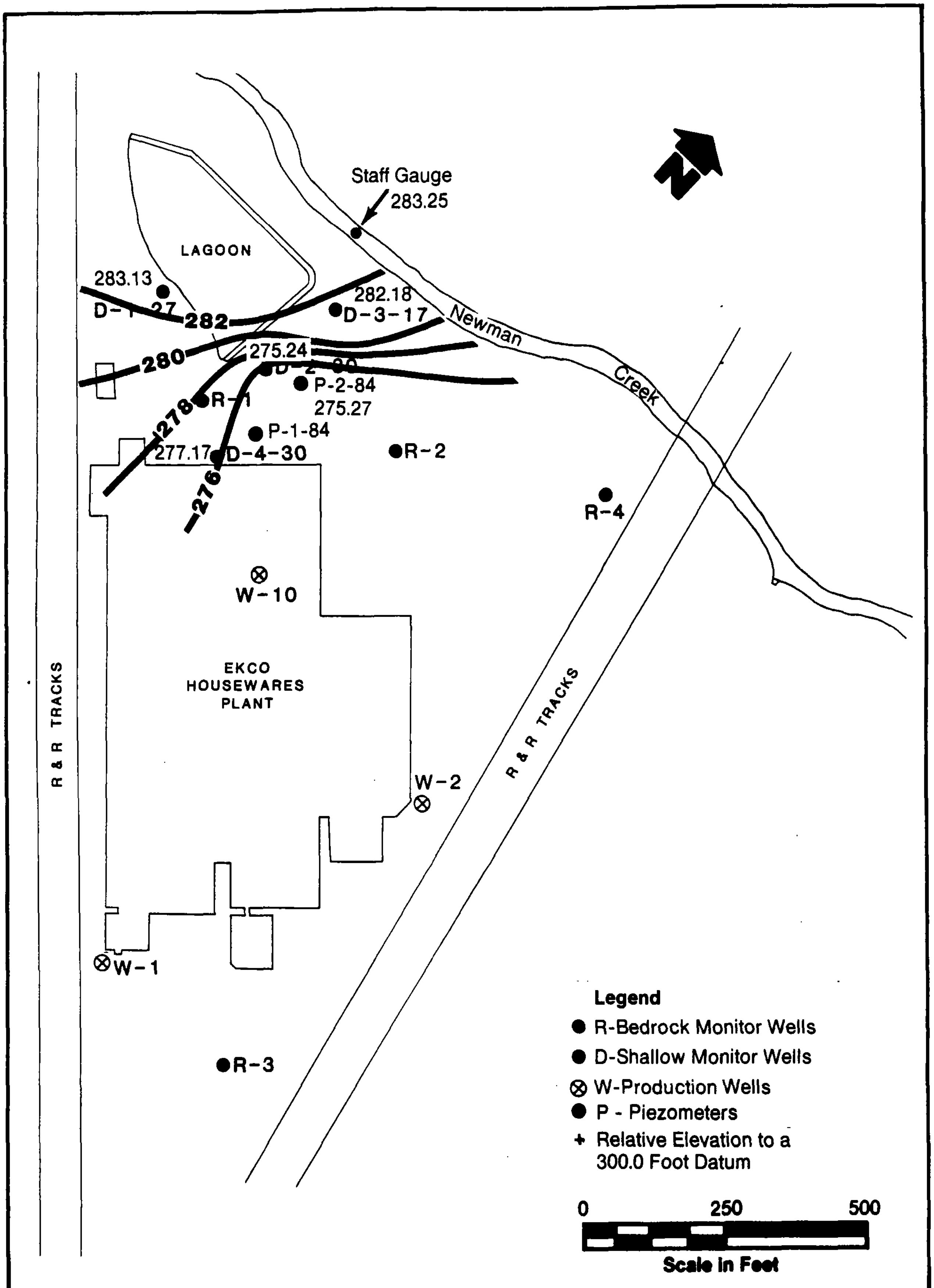


FIGURE 13 WATER TABLE PIEZOMETRIC ELEVATION+ IN THE WELLS INSTALLED IN UNCONSOLIDATED SEDIMENTS EKCO HOUSEWARES, INC., MASSILLON, OHIO

SECTION 3

GROUND WATER QUALITY ASSESSMENT

3.1 AQUIFER CHARACTERIZATION

In order to further characterize the aquifer system(s) beneath and surrounding EKCO Housewares, Inc., a recovery/drawdown pump test will be performed and fourteen (14) monitoring wells will be installed. These activities are described in the sections which follow.

3.1.1 Aquifer Testing

A recovery/drawdown test in the existing and proposed on-site wells will be performed in order to determine important aquifer properties such as transmissivity and storativity. These properties will help assess contamination migration rates and directions. But, because the aquifer system is stratified and laterally variable, responses from the monitor wells to the pumping changes are expected to vary according to well location and depth. These differences can affect contaminant migration rates and direction.

This test will be performed by shutting off the continuously pumping production well W-10, and monitoring the recovery rates of the bedrock wells. Several shallow wells will also be monitored during the test to assess whether the bedrock and unconsolidated units function as one or two hydrologic zones. The wells will be monitored until the water levels have reached near static conditions or for 48 hours, whichever comes first. It is not expected that the aquifer will reach a pre-stressed condition in 48 hours (48 hours is a restriction imposed by plant production requirements) but a time recovery curve will allow calculation of storativity and transmissivity. After these conditions have been met, pumping will resume in W-10 and the drawdowns will be monitored until the water levels have returned to near intial levels.

The procedures for recovery/drawdown testing are listed in Appendix A. A Pump Test Technical Memorandum which will include more specific protocols will be submitted to EPA at least two weeks prior to the start of the test.

An assessment as to whether small-scale pumping and/or slug tests shall be conducted to determine transmissivity in the shallow wells (unconsolidated wells) will be made upon completion of the wells. This assessment will be based upon the subsurface conditions encountered during drilling activities. The specific protocols for these small-scale pumping and/or slug tests will be included in the Pump Test Technical Memorandum which will be submitted to EPA two weeks prior to the start of these field activities.

3.1.2 Monitoring Well Installation

Fourteen (14) ground water monitoring wells will be installed to characterize the stratigraphy of the water bearing zone(s), to determine the depth to bedrock and to assess the hydrologic interconnection between the unconsolidated sand, gravel, silt and clay aquifer and the Pottsville sandstone.

3.1.2.1 Location Rationale

The approximate locations of the proposed monitoring wells are shown in Figure 14. Four downgradient wells (L-1, L-2, L-4 and L-5) including one upgradient well (L-3) will be installed around the lagoon in order to monitor the contaminant migration towards the Tuscarawas River and towards Newman Creek. These wells will serve as replacements for the existing D-wells (shallow monitoring). The existing D-wells are not considered to be adequate long term compliance monitoring points because of their inner diameter and poor development (each contained large amounts of sediment). However, since D-4-30 contains volatile organics, this well will continue to be a monitoring point during the ground water assessment and will be sampled at the same frequency as the other existing and proposed monitoring wells. The remaining D-wells will soley be used to monitor ground water elevations.

Four (4) additional on-site wells (I-2 through I-5) will be installed adjacent to existing bedrock monitoring wells in order to assess the horizontal extent of contaminants in the unconsolidated zone. (L-1, located near the lagoon, will also be installed next to a bedrock well). One (1) additional on-site bedrock well (R-5) will be installed on the north side of the lagoon to assess the potential for migration of contaminants from the lagoon to the Ohio Water Service Wells 1,2 and 3. These on-site wells will also help to identify any additional point sources of contamination. The former plant production well, W-2 will have its turbine removed and will then be capped with a removable lid to allow for sampling.

Required Modification

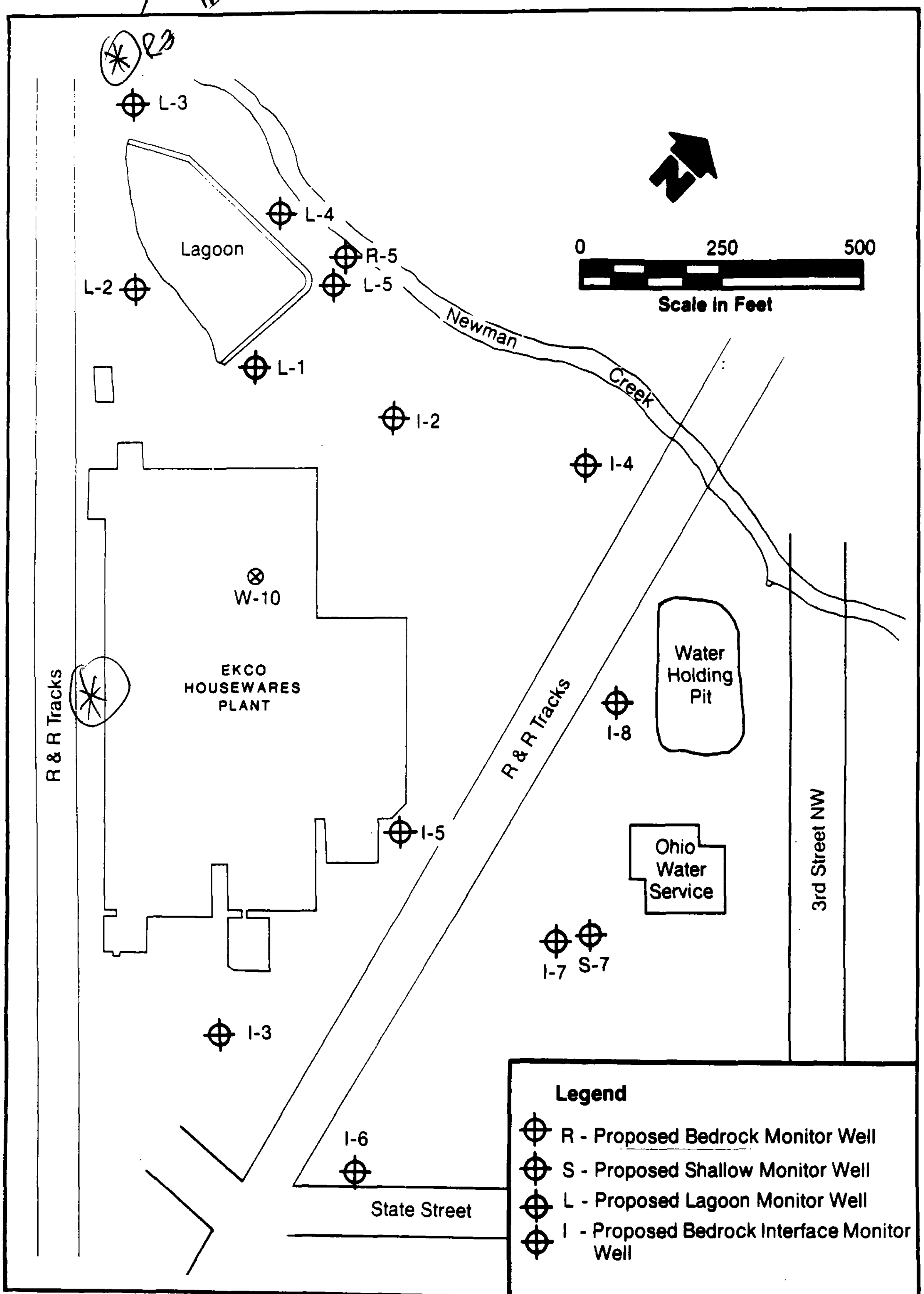


FIGURE 14 LOCATIONS OF PROPOSED MONITORING WELLS AT EKCO HOUSEWARE, INC., MASSILLON, OHIO

Off-site contaminant migration will be characterized by the installation of four (4) off-site wells. These wells will be located to define the lateral plume boundary. Three of the off-site wells (I-6 through I-8) will be installed to the bedrock interface and one well (S-7), located adjacent to I-7, will be installed 15 feet into the water table.

3.1.2.2 Monitoring Well Construction

The shallow and bedrock interface wells will be constructed of 4-inch diameter wound wire type 304 stainless steel screens and low carbon steel risers. Construction details are presented in Appendix B. The shallow monitoring wells L-1 through L-5 and S-7 will have 20-foot screens installed 15 feet into the first encountered water-bearing zone (in the unconsolidated sediments). These wells will serve to monitor the contaminants at or near the water table surface. The bedrock interface wells, I-2 through I-8 will be installed to the bedrock/unconsolidated sediment interface and will serve to monitor the contaminants potentially migrating along this interface. Because of the expected dip in the bedrock surface toward the northeast, wells drilled to the bedrock interface are estimated to be the equivalent depth of the on-site bedrock monitoring well. Thus, they will monitor lateral migration from bedrock to the valley unconsolidated sediments as well as contaminants moving along the interface from the site.

The proposed bedrock well (R-5) will be constructed of 4-inch low carbon steel casing installed 5 feet into competent rock. R-5 will be completed as a 4-inch open bedrock well to 80 feet below ground surface or approximately 40 feet into bedrock. This well will serve to monitor contaminants potentially migrating from the bedrock below the site to Ohio Water Service Wells 1, 2, and 3 which are installed in the unconsolidate valley outwash sediments.

3.2 SOURCE CHARACTERIZATION AND CONTAMINANT DISTRIBUTION

In order to determine the kinds, amounts, extent and source(s) surface water and stream sediment sampling, soil gas sampling, subsurface soil sampling and ground water sampling will be done at the Massillon EKCO Housewares site. These four activities are described in the sections which follow.

3.2.1 Surface Water and Stream Sediment Sampling

The surface water in Newman Creek will be sampled at three (3) locations in order to determine if plant activities have had any impacts on stream quality. The sample points shall be located upstream, adjacent to and downstream of the lagoon. Locations of the surface water sampling points are shown in Figure C-1 of Appendix C.

Specific protocols for surface water sampling are listed in Appendix C.

Five (5) stream sediment samples will also be taken in Newman Creek in order to determine potential impacts to the creek. Three (3) sample points will be located at the same locations as the surface water samples (i.e., upstream, adjacent to and downstream of the lagoon in the creek). Additional samples will be collected from two (2) locations which will lie between the adjacent and downstream samples. Locations of the stream sediment sampling points are shown in Figure C-1 of Appendix C.

Specific protocols for stream sediment sampling are listed in Appendix D.

3.2.2 Soil Gas Survey

Soil gas sampling will screen the shallow soils at the site for the presence of target volatile compounds. The soil gas survey will identify areas of elevated VOC's (above background level and/or above instrument detection limit) which could locate the potential source areas of these volatile compounds. Approximately one off-site and thirteen potential on-site point sources have already been identified which include:

- Buried fuel oil, gasoline and solvent blend tanks located around the perimeter of the plant building.
- Above-ground TCE tanks located outside of the plant building.
- Degreaser tanks within the plant building.
- Documented solvent spills within the proximity of process well W-10.
- An incinerator.
- Two hazardous waste storage areas.

- The lagoon.
- The waste discharge sewer lines.
- The railroad yard surrounding the property to the east and west.

Figure 15 locates these potential point sources.

Soil gas sampling will be performed initially on a 50-foot spacing along the foundation of the facility and in the areas of suspect point sources. If VOC's are observed at levels of concern (above background level and/or above instrument detection level), a grid will be established perpendicular to the foundation of the facility and will be reduced to 25 feet in order to establish the limit of a plume or the location of a point source. The grid system will continue until the observed VOC levels drop off to background levels or until the property boundary is reached, whichever occurs first. The soil gas along the entire perimeter of the plant will be sampled in order to fully characterize the site.

Subsequent soil borings will be advanced in areas of high soil gas readings in order to quantitatively verify the quantity and vertical distribution of the volatile compounds present in the soils in these areas.

Appendix E contains specific protocols for the soil gas sampling.

3.2.3 Soil Boring Installation

In order to further define the extent and to quantify the levels of VOC's, soil samples will be collected from soil borings using sample drivers at the locations where elevated VOC's were identifed in the soil gas survey. Between ten and fifteen borings are anticipated to be drilled to the top of the water table. One additional boring will be drilled to the top of the water table at a location where no VOC's were detected in the soil gas survey. This boring will serve to establish baseline soil conditions. The exact number and location of soil borings will be finalized after the results of the soil-gas survey have been reviewed. Proposed soil sampling locations will be presented to EPA two weeks prior to field activity.

Soil samples will be collected continuously at each boring location and will be logged by the on-site geologist. Of

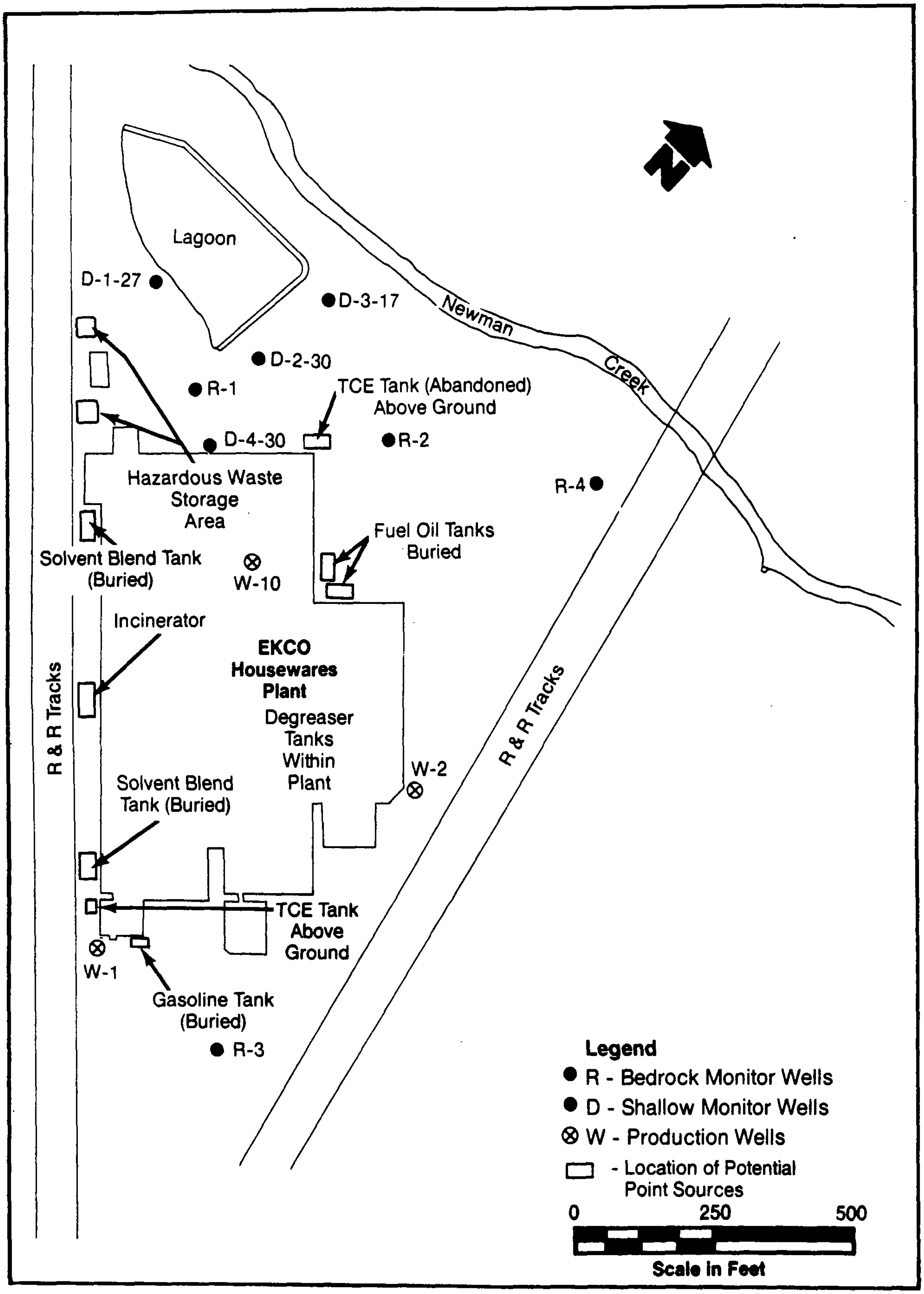


FIGURE 15 POTENTIAL POINT SOURCE LOCATIONS
EKCO HOUSEWARES, INC., MASSILLON, OHIO

these, three will be collected for analyses. Samples for analysis will be collected from depths of 0-2 feet, 4-6 feet and 10-12 feet below ground surface or at the discretion of the on-site geologist based upon vapor detection, discoloration or other field indicators. The samples will be analyzed for HSL VOCs, metals and cyanide.

Specific protocols for soil boring installation are listed in Appendix F.

3.2.4 Monitoring and Production Well Sampling

The objective of this sampling task is to characterize the ground water contaminants, determine the direction of any contaminant migration from the site and to delineate the contaminant plume. This will entail the sampling of the proposed and existing on- and off-site wells (R-1 through R-5, W-1, W-2, W-10, L-1 through L-5, I-2 through I-8 and S-7) and Ohio Water Service Company Well No. 4. Each well will be sampled for HSL VOCs, metals and cyanide.

Specific protocols for ground water sampling are listed in Appendix G.

SECTION 4

RCRA CLOSURE MONITORING PLAN

4.1 SLUDGE CHARACTERIZATION

To sufficiently characterize the material within the lagoon, a total of nine test borings will be drilled. Six borings will be bottom soil borings (BSB) and will be drilled to a depth of at least 16 feet below grade in the bottom of the lagoon. The remaining three borings will be slope soil borings (SSB) and will be drilled to a depth of at least six feet below grade on the encircling berm and embankment. Figure 16 locates the proposed lagoon soil borings and Figure 17 illustrates a plan view of each type of boring.

The BSB will be located on two perpendicular lines with the lateral line starting at the former lagoon outfall and running approximately north to south. Two BSB will be located on the lateral line, one on each side of the longitudinal line. The longitudinal line will run lengthwise in the lagoon and will locate the remaining four BSB; one east of the latitudinal line and three in the western end of the lagoon. Each BSB will be sampled continously with a 2-foot split spoon sampler giving a total of 8 samples per boring. Each sample will be analyzed for total metals. Four of these samples (the 1st, 3rd, 5th and 8th sample) will also be analyzed for volatile organics.

Since the lagoon is roughly triangular in plan view, one SSB will be located on the northern berm, one on the eastern berm, and one on the natural embankment which forms the southwest boundary. Continuous split spoon samples will be taken from each SSB boring. Each SSB sample will be analyzed for total metals. Volatile organic analyses will also be performed on the first (sludge) and the last sample from each SSB.

4.2 GROUND WATER MONITORING

In order to complete the lagoon compliance monitoring network as required by RCRA, four downgradient monitoring wells (L-1, L-2, L-4 and L-5) will be installed adjacent to the lagoon in the upper water bearing zone. One of these wells (L-4) will be located between the lagoon and Newman Creek. One upgradient well (L-3) will also be installed to provide background ground water quality data. Figure 14 illustrates the locations of the proposed wells.

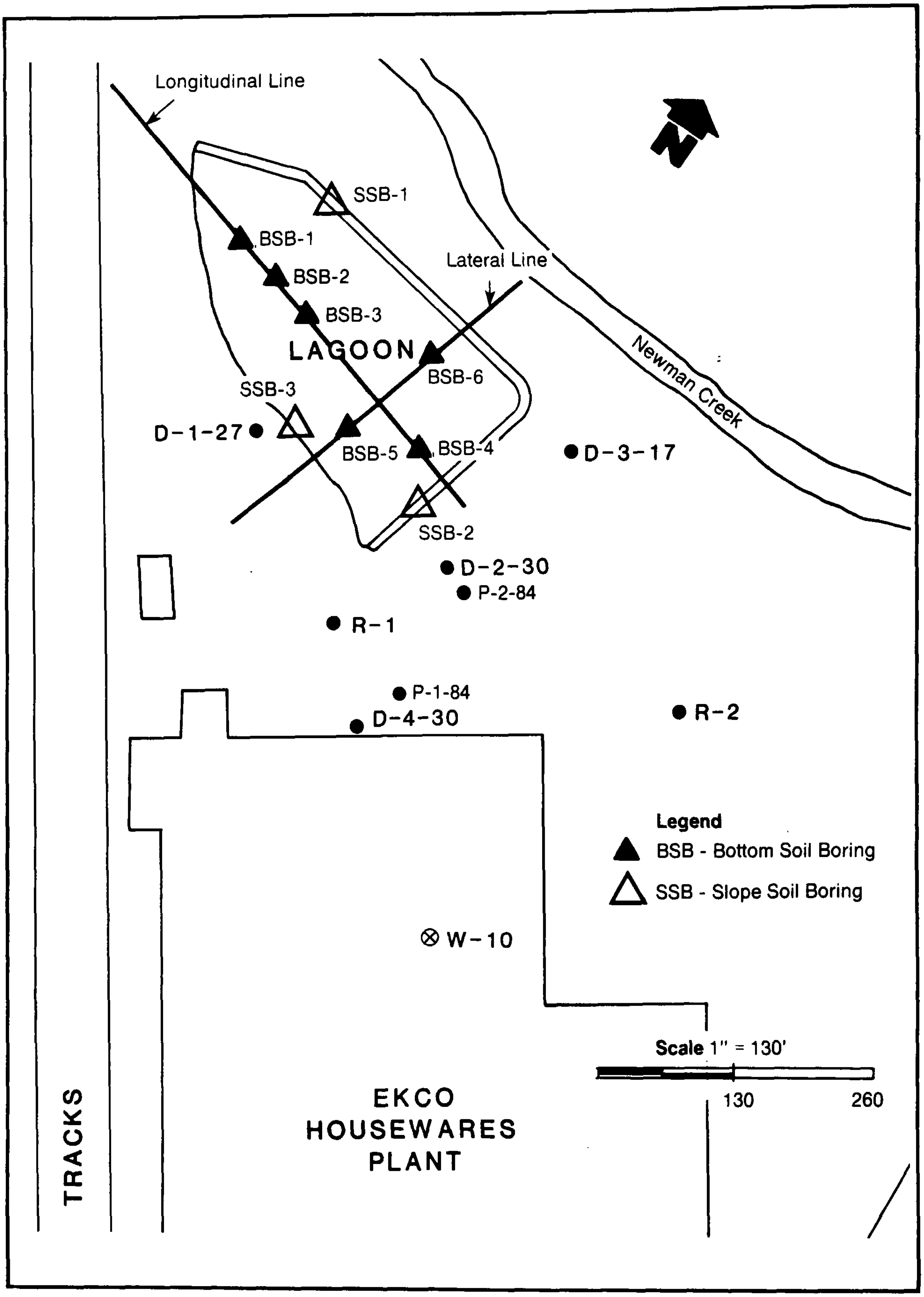


FIGURE 16 LOCATIONS OF LAGOON SOIL BORINGS
EKCO HOUSEWARES, INC., MASSILLON, OHIO

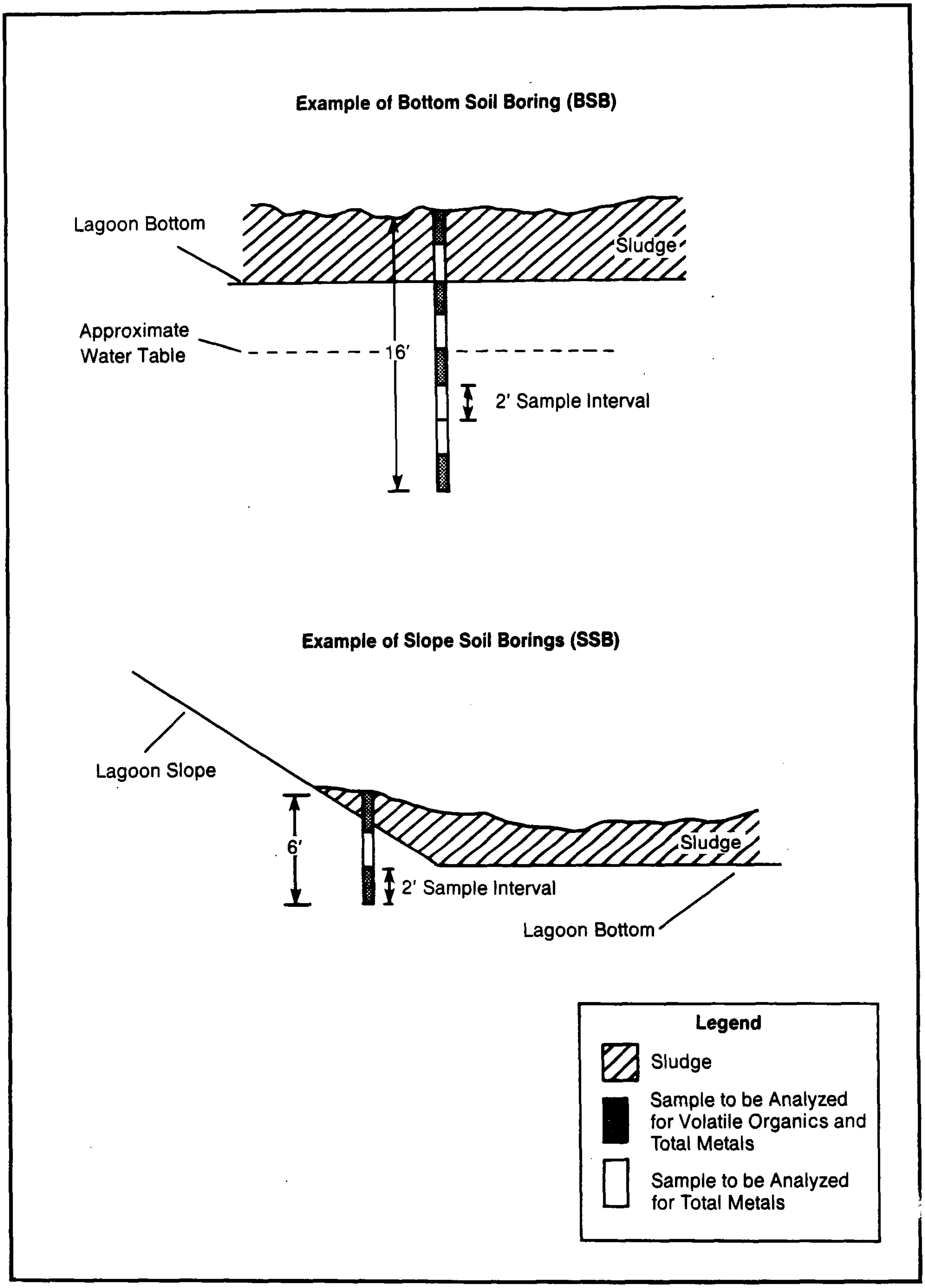


FIGURE 17 PLAN VIEW OF THE BOTTOM SOIL BORINGS (BSB) AND SLOPE SOIL BORINGS (SSB)

Each well will be drilled by cable tool or auger techniques and will be constructed of 20 feet of 4-inch I.D. wound wire stainless steel screen. The screen will be set 15 feet into the first encountered water bearing zone. A 4-inch I.D. low carbon steel riser pipe will be connected to the screen with stainless steel couplings. A monitoring well construction diagram is shown in Appendix B on Figure B-1.

The wells will be developed using the procedures described in Appendix B. The wells will be sampled using the procedures described in Appendix G.

The existing wells surrounding the lagoon (D-1-27 through D-4-30) were constructed of 1 1/2-inch I.D. PVC casing and screen and were not developed adequately to be used for long-term compliance monitoring.

SECTION 5

CORRECTIVE ACTION ANALYSIS

5.1 INTRODUCTION

Ground water modeling will be performed as part of a ground water assessment plan to evaluate the effectiveness of the on-going ground water recovery program and air stripping activities relating to removal of contaminants in the ground water. The modeling effort will also provide assistance in identifying areas that may require additional field study and in evaluating alternative scenarios for the location and pumping rates of various extraction well scenarios for the site.

5.2 CONCEPTUAL MODEL

A compilation and review of the available existing hydrogeologic data will be performed to provide the framework for the conceptual model of the site. These information primarily include geologic and hydrologic data, well locations, water levels, water quality, and pumping rates for production wells. From this data, conceptual model of the ground water flow and contaminant migration system is developed to generate the relevant properties and conditions of the real flow systems and contaminant transport in a form suitable for treatment by mathematical models. The development of the conceptual model requires a knowledge of the hydrology and geology of the physical system of the site. Simplifying assumptions will be carefully selected to accommodate data uncertainties and the complex spatially and temporally variable hydrogeologic parameters. Boundary and initial conditions are chosen to represent the site conditions accurately and to facilitate mathematical treatment.

The Prickett-Lonnquist SUPER PLASM/RANDOM WALK models have been widely used to evaluate ground water flow and solute transport problems. These two models are proposed to be adopted in the investigation of contaminant migration for the EKCO site and its vicinity area because of:

- o Availability of a properly documented computer code.
- o Ability of the models to simulate the hydrogeologic conditions of the site.

- o Ability of the models to represent local climatological conditions and to simulate seasonal pumping from the production wells.

- o Ability of the models to simulate contaminant transport due to advection, dispersion and sorption.

In order to put the conceptual model into a manageable form for the purpose of this study, many simplifications and approximations are required, and thus the conceptual model will be continually reassessed and justified on the basis of the numerical modeling experience and further synthesis of collected data. Prior to application of the groundwater flow and contaminant transport models, the models will be calibrated because of the uncertainty in selecting representative parameter values for the study area. Model calibration will be performed by comparing model computed values to observed data.

The ground water modeling will be performed in conjunction with the soil-gas survey and the deep boring/monitoring well program. Information obtained from these concurrent activities are incorporated into the model input data. A numerical calibrated model will be designed based on the developed conceptional model to simulate the existing ground water flow and distribution of contaminant concentrations, to estimate the effects of various recovery well scenarios on the ground water and contaminant distributions, and recovery time required to control the contaminant plume in the study area.

5.3 GROUND WATER FLOW MODEL

The ground water flow model, PLASM, was developed based on the principle of mass conservation for the entire ground water system. The model is used to simulate horizontal flow in the nonhomogeneous and isotropic aquifer of the site. The numerical solution of the flow model consists of the following procedures:

- o Divide the continuous aquifer system of the study area into an equivalent set of discrete elements.

- o Write the equations representing the ground water flow in the discretized model in a finite-difference form.

- Solve the resultant matrix equations numerically by a modified interative alternating direction implicit method.

5.4 CONTAMINANT TRANSPORT MODEL

The RANDOM WALK model for contaminant transport in the ground water system was developed based on the principle of mass conservation for contaminants, which can be stated as: the time rate of change of contaminant in the ground water system is equal to the sum of the sources and sinks of contaminant in the system. Instead of solving the advection-dispersion equation completely; the Lagrangian approach is employed to handle the advection terms in the transport model. The process utilizes the random walk method for statistically significant numbers of particles wherein each particle is advected with the mean velocity and randomly dispersed according to specified dispersivities. In the random walk method, each particle has an associated weight and retardation rate. Contaminant concentration at any time is calculated from the particle distribution as the total particle weight divided by the water volume in which the specific particles presently reside.

One parameter that is important is determining the contaminant concentrations in ground water is the distribution coefficient. This coefficient in the transport model represents the ratio of the contaminant concentration absorbed on soil particles to the contaminant concentration in ground water under instantaneous equilibrium condition during the adsorption-desorption process. This is the simplest and most widely implemented linear model to describe equilibrium absorption. The values of the distribution coefficient for the EKCO site vary depending on soil properties, pH of the ground water, chemical content (such as organic content), and nature of the contaminant. In the transport model, the retardation factor is used to account for retardation of the contaminant movement relative to ground water flow caused by chemical reactions of contaminants with the aquifer medium. If the equilibrium absorption is reached, the contaminant should move at a constant average velocity equal to the ground water velocity divided by the retardation factor.

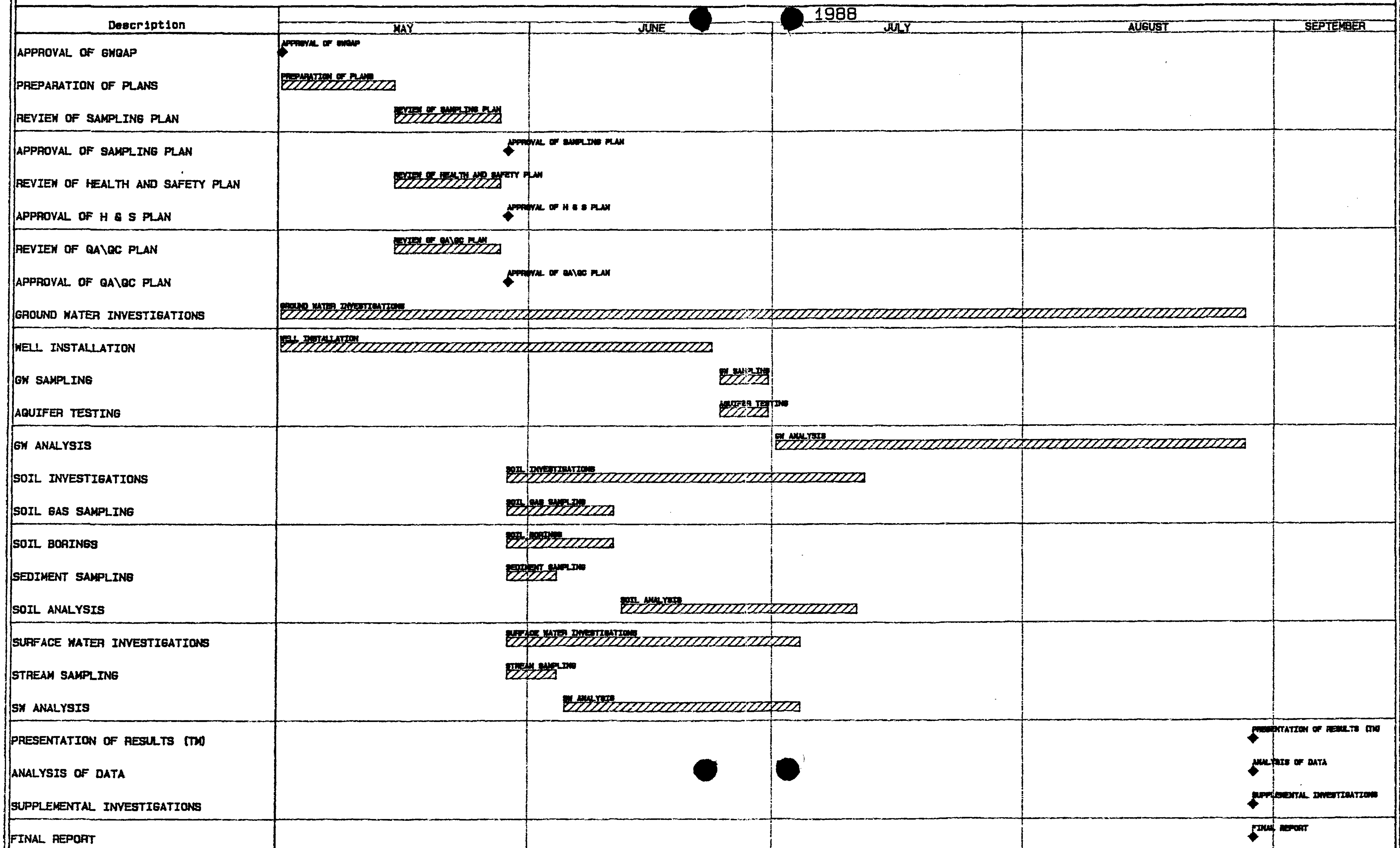
The modeling effort required for the ground water assessment depends on what level of analysis is required to meet the objectives of the study. Therefore, the determination of proposed models to be used at the EKCO site is tentative. A more appropriate numerical model may be selected after discussion with EKCO's personnel. The form of the numerical model and its parameters are subject to change as new information from field studies is available. For instance, if field data for three-dimensional flow and mass transport simulation are inadequate or two-dimensional cross-section is sufficient to address the problem of EKCO site, the U.S. Geological Survey models will be suggested in the future.

SECTION 6

SCHEDULE

The planned schedule for the EKCO Housewares, Inc. Ground Water Assessment Plan is shown in Figure 18. The overall start date for the process coincides with agency approval of the plan. This plan includes the scope for the Phase II Site Characterization work. This plan also allows for Supplemental Field Investigation (Phase III), if necessary. This work cannot be scoped at this time and the level of effort or time required cannot be determined. Therefore, the schedule shown in Figure 18 for the Phase III field work indicates a solid bar followed by a dashed line with indeterminate completion dates for the work tasks. The solid bar designates a schedule for planning purposes and dashed line reflects a possible extension in schedule depending on future scope of work. This Phase III field effort would also affect the time for completion of the Corrective Action Plan.

EKCO HOUSEWARES GROUNDWATER ASSESSMENT PLAN SCHEDULE



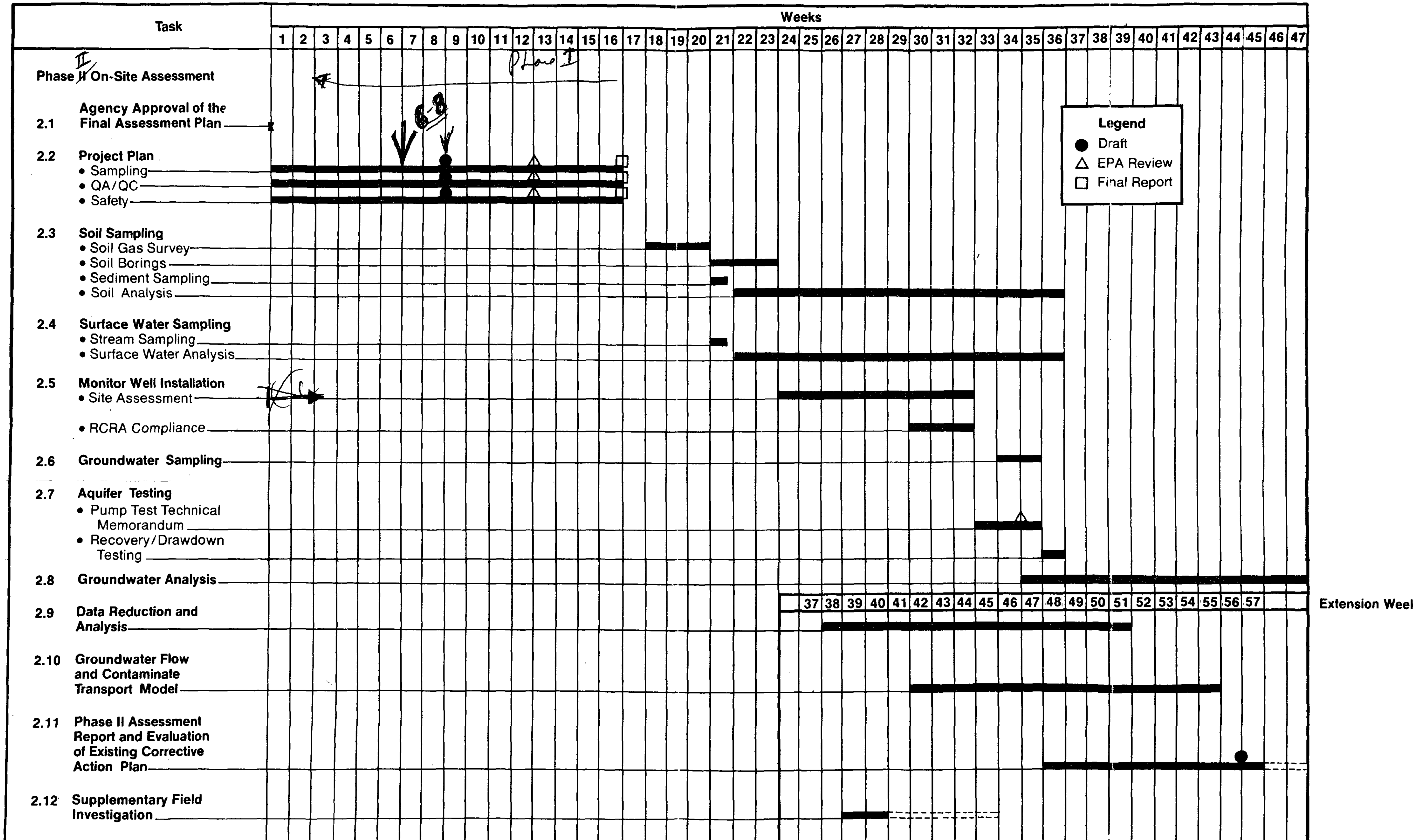


FIGURE 18 PHASE II SCHEDULE

SECTION 7

REFERENCES

Cross, W.P., and R.E. Hedges, 1959. Flow Duration of Ohio Streams. Ohio Water Plan Inventory, Bull. 31, Report No. 3.

Floyd Brown Associates, 1986. Closure Plan Presentation. Memorandum Draft, 4 November 1986.

Morningstar, H., 1922. Pottsville Fauna of Ohio. Ohio Division of Geological Survey, Fourth Series, Bulletin 25.

Ohio Department of Natural Resources, 1972. Northeast Ohio Water Plan, Main Report.

Roy F. Weston, Inc., 1988, Interim Measures Report for EKCO Housewares, Inc., Massillon, Ohio. February 1988.

Schmidt, J.J., 1962. Middle Tuscarawas River and Sugar Creek Basins Underground Water Resources. Ohio Water Plan Inventory.

Walker, A.c., 1979. Ground-Water Resources of Stark County. Ohio Department of Natural Resources.

ATTACHMENT A

NPDES PERMITS

OhioEPA

OEPA Permit No. C 309 *AD

Application No. OH 072 OYD 2 000026

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Chapter 6111),

EKCO HOUSEWARES COMPANY

is authorized to discharge from a facility located at

State Avenue Extension, N. W.
Massillon, Ohio 44646

to receiving waters named

Newman Creek

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on July 22, 1974

This permit and the authorization to discharge shall expire at midnight, June 30, 1979. Permittee shall not discharge after the above date of expiration. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Ira L. Whitman

Ira L. Whitman
Director

OEPA-NPDES-7

OEPA-NPDES-7

OEPA Permit No. C 309 *AD

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - INITIAL

1. During the period beginning July 22, 1974 and lasting until September 30, 1975, the permittee is authorized to discharge from outfall(s) serial number(s) 601

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/day (MGD)	-	-	-	-	twice per month	continuous
Total Suspended Solids	6 (13)	12 (26)	-	-	twice per month	composite
Dissolved Copper	0.15 (.33)	0.3 (.66)	-	-	twice per month	composite
Dissolved Iron	0.3 (.66)	0.6 (1.3)	-	-	twice per month	composite
Dissolved Nickel	0.6 (1.3)	1.2 (2.6)	-	-	twice per month	composite
Oil & Grease	22 (48)	44 (96)	-	-	twice per month	grab

2. The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored twice per month by reporting the minimum and maximum for one day.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts.

4. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations(s): prior to mixing with any cooling water.

OEPA-NPDES-7

PART I

OEPA Permit No. C 309 *AD

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - FINAL

1. During the period beginning October 1, 1975 and lasting until June 30, 1979, the permittee is authorized to discharge from outfall(~~s~~) serial number(s) 601
3

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/day (MGD)	-	-	-	-	twice per month	continuous
Total Suspended Solids	6 (13)	12 (26)	-	-	twice per month	composite
Dissolved Copper	0.15 (.33)	0.3 (.66)	-	-	twice per month	composite
Dissolved Iron	0.3 (.66)	0.6 (1.3)	-	-	twice per month	composite
Dissolved Nickel	0.6 (1.3)	1.2 (2.6)	-	-	twice per month	composite
Oil & Grease	6 (13)	12 (26)	-	-	twice per month	grab

2. The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored twice per month by reporting the minimum and miximum for one day.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts.

4. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations(s): Prior to mixing with any cooling water.

53

OHIO ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION OF NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM(NPDES)PERMIT

ISSUE DATE: ~~April 7, 1975~~

EXISTING PERMIT NO: ~~C 309 *AD~~

EFFECTIVE DATE: June 17, 1975

APPLICATION NO: ~~C 309 *BX~~

ENTITY NAME: Ekco Housewares Company

FACILITY LOCATION: State Avenue Extension, N.W.. Massillon, Ohio 44646

In accordance with the provisions of Ohio Environmental Protection Agency Regulation EP-31-06, the above-referenced NPDES permit is hereby modified as follows:

Page 2 - Initial Limitations Table No longer Applicable
Page 3 - Modified Beginning Date and Outfall Number
Page 4 - Modified Reporting Address
Page 6 - Schedule of Complaince is No longer Applicable
Page 13 - Modified Other Requirements

Attached are the modified pages to the NPDES permit. (M2) (M3) (M4) (M6) (M13)

All terms and conditions of the existing permit not recommended for modification by this document will remain in effect. Further, any existing term or condition which this modification will change will remain in effect until any legal restraint to the imposition of this modification has been resolved.

When this modification is effective, the OEPA permit number will be changed to C 309 *BD The application number will change to OH0003956.

Ned E. Williams

Ned E. Williams, P.E.
Director

OEPA-NPDES-38

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning June 17, 1975 and lasting until June 30, 1979 the permittee is authorized to discharge from outfall(s) serial number(s) 001.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day)		Other Units (Specify)		MONITORING REQUIREMENTS	
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency	Sample Type
Flow-M^3/day (MGD)	-	-	-	-	twice per month	continuous
Total Suspended Solids	6 (13)	12 (26)	-	-	twice per month	composite
Dissolved Copper	0.15 (.33)	0.3 (.66)	-	-	twice per month	composite
Dissolved Iron	0.3 (.66)	0.6 (1.3)	-	-	twice per month	composite
Dissolved Nickel	0.6 (1.3)	1.2 (2.6)	-	-	twice per month	composite
Oil & Grease	6 (13)	12 (26)	-	-	twice per month	grab

2. The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored

3. There shall be no discharge of floating solids or visible foam in other than trace amounts.

4. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations(s): Prior to mixing with any cooling water.

LP3

wP3

OEPA Permit No. C 309 *BD

PART III

OTHER REQUIREMENTS

Monthly reports to Ohio EPA shall contain the following reporting codes and units.

Effluent Characteristic	Reporting Code	Units Used in Reporting
Flow	50050	MGD (million Gallons/day)
Total Suspended Solids	00530	mg/l
Dissolved Copper	01040	ug/l
Dissolved Iron	01046	ug/l
Dissolved Nickel	01065	ug/l
Oil & Grease	00550	mg/l
pH	00400	S.U.

* The pH of the infiltration lagoon, station C 309 502 shall be monitored weekly with a grab sample.

WPI

Ohio EPA

July, 1983

Ekco Housewares Company
Ekco Massilon Division
State Avenue Exit N.W. Box 560
Massillon, Ohio 44646

Dear NPDES Permit Holder:

Coincident with the establishment of a new permit number must be the incorporation of that new number in your station codes. For your convenience you will find listed below your old numbers along with the newly derived numbers and the current description we have for your reporting station(s). This information has also been incorporated in pre-printed EPA-4500 Report Forms generated for your facility.

Sincerely,

Sandra J. Turner, Manager,
Permits & Compliance Programs Section

STATION SUMMARY

OLD-ID.	NEW.-ID.	DESCRIPTION
C309	3IC00009001	001 Outfall, Newman Crk., Effluent From Plant
	3IC00009502	502 Infiltration Lagoon

State of Ohio Environmental Protection Agency
361 E. Broad St., Columbus, Ohio 43216-1049, (614) 466-8565

WP6

Please print or type in the unshaded areas only.

EPA I.D. NUMBER (copy from Item 1 of Form 1)
OH00033956

Form Approved OMB No. 158-R017

FORM 2C NPDES

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY
APPLICATION FOR PERMIT TO DISCHARGE WASTEWATER
EXISTING MANUFACTURING, ~~COMMERCIAL, MINING AND SILVICULTURAL OPERATIONS~~
Consolidated Permits Program

I. OUTFALL LOCATION

For each outfall, list the latitude and longitude of its location to the nearest 15 seconds and the name of the receiving water.

A. OUTFALL NUMBER (list)	B. LATITUDE 1. DEG.	2. MIN.	3. SEC.	C. LONGITUDE 1. DEG.	2. MIN.	3. SEC.	D. RECEIVING WATER (name)
001	40	48	30	81	31	50	Newman Creek
502	40	48	30	81	32	05	Lagoon

NOTE: The use of Outfall #502 was discontinued approximately March, 1985.

II. FLOWS, SOURCES OF POLLUTION, AND TREATMENT TECHNOLOGIES

A. Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluer and treatment units labeled to correspond to the more detailed descriptions in Item B. Construct a water balance on the line drawing by showing avera flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined (*e.g., for certain mining activities*), provide pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

B. For each outfall, provide a description of: (1) All operations contributing wastewater to the effluent, including process wastewater, sanitary wastewate cooling water, and storm water runoff; (2) The average flow contributed by each operation; and (3) The treatment received by the wastewater. Continu on additional sheets if necessary.

1. OUTFALL NO (list)	2. OPERATION(S) CONTRIBUTING FLOW a. OPERATION (list)	b. AVERAGE FLOW (include units)	3. TREATMENT a. DESCRIPTION	b. LIST CODES FRC TABLE 2C-1	
001	Cooling Water	380 GPM	Air Stripper	4	A
				5	T
001	Storm Water	15,000 GPD	None		

OFFICIAL USE ONLY (effluent guidelines sub-categories)

ATTACHMENT B

WELL CONSTRUCTION SUMMARY DETAILS

WESTON

WELL CONSTRUCTION SUMMARY DETAILS

Well No.	Type	Total Depth	Comments
P-1-84	1 1/4" piezometer. 3 feet of screen at bottom.	22 feet	H_2O Level = 17 feet. Backfilled with clean gravel, then bentonite to the surface.
P-2-84	1 1/4" piezometer. 5 feet of slotted pipe at bottom.	33 feet	H_2O Level = 17.5 feet. No information about gravel pack/seal is available.
TH-3-84	Test hole. Never completed as a well.	10 feet	H_2O Level = 10 feet. No information about grout/seal is available.
TH-4-84	Test hole. Never completed as a well.	24 feet	No information about grout/seal is available.
R-1	6" monitor well. Open hole from 42 to 175 feet below ground surface. Cased to 42 feet.	175 feet	H_2O Level = 38 feet. No information about grout/seal is available.
R-2	6" monitor well. Open hole from 46 to 179 feet below ground surface. Cased to 46 feet.	179 feet	H_2O Level = 43 feet. No information about grout/seal is available. Well filled to 150 feet.
R-3	6" monitor well. Open hole from from 37 to 175 feet. Cased to 37 feet.	175 feet	H_2O Level = 41 feet. No information about grout/seal is available. Hole filled to 160 feet.
R-4	6" monitor well. Open hole from 92-165 feet. Cased to 92 feet.	165 feet	H_2O Level = 13 feet. No information about grout/seal is available.

WESTON
MANAGERS DESIGNERS/CONSULTANTS

WELL CONSTRUCTION SUMMARY DETAILS

Well No.	Type	Total Depth	Comments
D-1-27	1 1/2" monitor well. 15 feet of screen at bottom.	27 feet	H_2O Level = 20 feet. Sand packed to 10 feet. 2 feet of bentonite pellet seal. Cement/bentonite grout to the surface.
D-2-30	1 1/2" monitor well. 10 feet of screen at bottom.	30 feet	H_2O Level = 25 feet. Sand packed 2 feet above screen with 2.5 feet of bentonite pellet seal above. Cement/bentonite grout to surface.
D-3-17	1 1/2" monitor well. 10 feet of screen at bottom.	17 feet	H_2O Level = 8 feet. Sand packed 2 feet above screen with 2 feet of bentonite pellets above this. Grouted to surface.
D-4-30	1 1/2" monitor well. 15 feet of screen at bottom.	30 feet	H_2O Level = 26 feet. Sand packed 2 feet above screen with 2 feet of bentonite pellets seal above this. Grouted to the surface.

APPENDIX A

AQUIFER TESTING PROTOCOL

APPENDIX A

AQUIFER TESTING PROTOCOL*

(1) Measure depth to water with a clean water level indicator in all on- and off-site wells. Establish background water level conditions with a continuous recorder in one bedrock and one unconsolidated well for at least 12 hours before the start of the test.

(2) Turn off pump in production well W-10. Hold the pumping rate constant in production well W-1 during the test.

(3) Measure recoveries in all wells with a Hermit, SE-200 data logger or equivalent at the following intervals:

Time Since Pumping Stopped (in minutes)	Time Interval Between Measurements (in minutes)
0-10	.5-1
10-15	1
15-60	5
60-300	30
300-1440	60
1440-termination of test	480 (8 hours)

(4) Record depth to water data after the specified time interval.

(5) Continue the test until the water levels have returned to near static conditions (3 or more consecutive readings) or up to 48 hours, which ever comes first.

(6) After the water levels have reached near static conditions or after 48 hours, resume pumping in W-10 at the same rate as before the start of the test.

(7) Measure drawdowns in all wells at the intervals specified in Step 3.

* A pump test Technical Memorandum which will include more specific protocols will be submitted two weeks prior to the start of the test.

(8) Continue the test until the water levels have returned to near the pre-test levels or up to 24 hours, whichever comes first.

(9) Obtain flow rate records of Ohio Water Service Wells 1, 2, and 3 for the test period.

(10) The data will be used to calculate the transmissivity and storativity of the aquifer(s) beneath the site and to assess well response in the different hydraulic zones.

APPENDIX B

MONITORING WELL INSTALLATION PROTOCOL

APPENDIX B

MONITORING WELL INSTALLATION PROTOCOL

(1) The locations of the monitoring wells will be staked, cleared of underground obstructions and utilities and then will be approved by representatives of EKCO.

(2) A cable tool rig will be utilized for the drilling of the wells. All downhole equipment will be steam cleaned prior to advancing each hole.

(3) Soil samples for lithologic description will be collected at 5-foot intervals above the anticipated screened depth interval and continuously thereafter. Continous soil samples will be collected from one off-site interface well. Since S-7 is to be located directly adjacent to I-7, no soil samples for lithologic description will be taken. All soil samples will be collected from decontaminated sample drivers. The sample drivers will be decontaminated before collection by rinsing with Alconox and potable water.

(4) Rock cutting samples for lithologic description will be collected at 5-foot intervals in well R-5 with a cable tool bucket. The unconsolidated material above the bedrock will be sampled at 5-foot intervals for lithologic description.

(5) An HNu and PID will be used to detect any volatile organics as the split spoon driver is opened or when rock cuttings are brought to the surface.

(6) A description of the sample will be recorded in the field log, including:

- o Split spoon/sample depth;
- o Blow counts;
- o Downhole air monitoring measurements as well as HNu readings as the split spoon is opened or when rock cuttings are brought to the surface;
- o Grain size and texture (e.g., fine sand, silty clay);
- o Color based on visual inspection;

- Moisture content (i.e., dry, moist, wet);
- Other detailed observations (staining of soil, driller's comments, construction rubble containing bricks, tires, broken bottles).

(7) Representative samples of each type of lithology will be collected for stratigraphic evaluation and will be retained in clean, wide-mouth sampling jars.

(8) The wells will extend to the depth indicated on Table B-1. The wells will contain screen lengths as also indicated on Table B-1.

(9) The wells will be constructed as shown in Figure B-1. Similar construction of I-2 and I-4 through I-8, will be used except that 10 feet rather than 20 feet of screen will be used. Well R-5 will be an open bedrock well (no screen) and will be cased with 4-inch low carbon steel 5 feet into competent rock. This well will be sealed with 2 feet of bentonite pellets at the bedrock/soil interface and then grouted to the surface.

(10) The monitor wells will be developed by bailing, surging or pumping until at least five well casing volumes have been removed and a clear sediment-free flow has been obtained. The purge water will be collected in a tanker and then taken to the air stripper for processing.

(11) The cuttings will be stockpiled, pending disposal, on plastic-lined sheets and then covered.

(12) Upon completion of drilling, all wells will be surveyed and their elevations will be determined with respect to an established National Geodetic Vertical Datum (NGVD).

TABLE B-1

WELL DEPTH AND SCREEN LENGTH

Well No.	Location of Bottom of Screen	Screen Length (feet)	Anticipated Depth of Well (feet below ground surface)
L-1	15' into first H_2O bearing zone	20	35
L-2	15' into first H_2O bearing zone	20	35
L-3	15' into first H_2O bearing zone	20	40
L-4	15' into first H_2O bearing zone	20	40
L-5	15' into first H_2O bearing zone	20	35
I-2	To top of bedrock	10	44
I-3	To top of bedrock	10	32
I-4	To top of bedrock	10	92
I-5	To top of bedrock	10	70
I-6	To top of bedrock	10	60
I-7	To top of bedrock	10	150
I-8	To top of bedrock	10	120
S-7	15' into first H_2O bearing zone	20	45
R-5	N/A (open bedrock well)	N/A	80

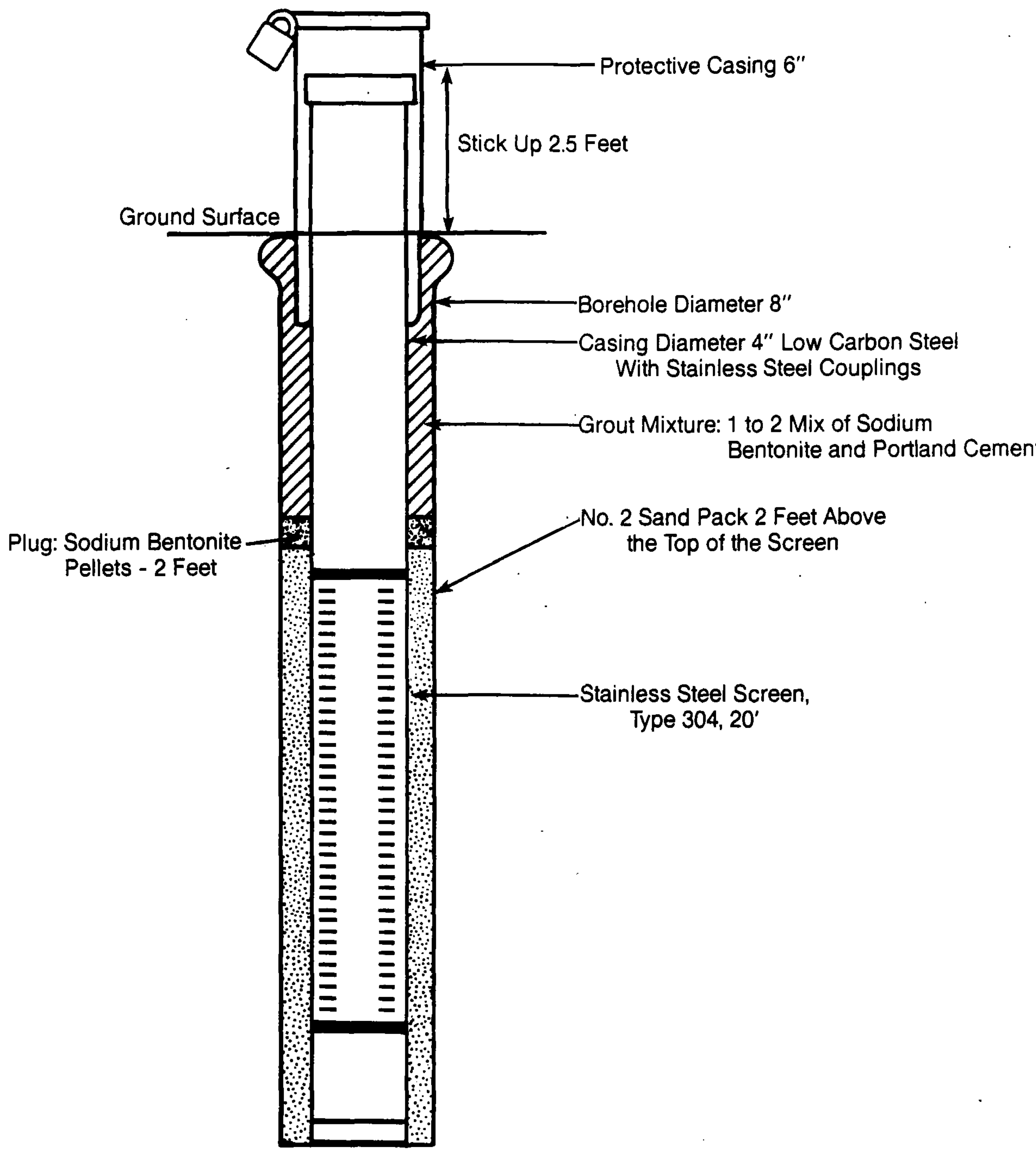


FIGURE B-1 SUMMARY SPECIFICATIONS FOR MONITOR WELL COMPLETION

APPENDIX C

SURFACE WATER SAMPLING

APPENDIX C

SURFACE WATER SAMPLING

(1) During low flow conditons, three (3) surface water samples will be taken from Newman Creek at the location shown in Figure C-1.

(2) Each location will be staked before sampling.

(3) The stream will be sampled in a downstream to upstream fashion. The sampler will stand downstream of the sampling point while collecting the sample.

(4) The samples will be collected directly into labeled sample bottles with exception to the sample bottles containing preservative. The samples for metals and cyanide analyses will be collected in clean, unused containers and then poured into the appropriate preserved container.

(5) Each sample will be analyzed for HSL VOCs, metals, cyanide and for field parameters (pH, temperature and specific conductivity).

(6) All pertinent information will be recorded in the field log book (time of collection, field parameter data, physical characteristics of the sample, etc.).

(7) A VOC field water blank will be prepared for each day of shipping.

(8) A duplicate sample will be taken at the downgradient location.

(9) Table C-1 contains a summary of the surface water sampling.

(10) The samples will be prepared for shipment (placed in vermiculite-filled coolers with chain-of-custody seals) and will be entered on a chain-of-custody form.

(11) After sampling the velocity of the stream will be measured by placing a floatation device into the stream and measuring the time it takes to travel a known

WESTON

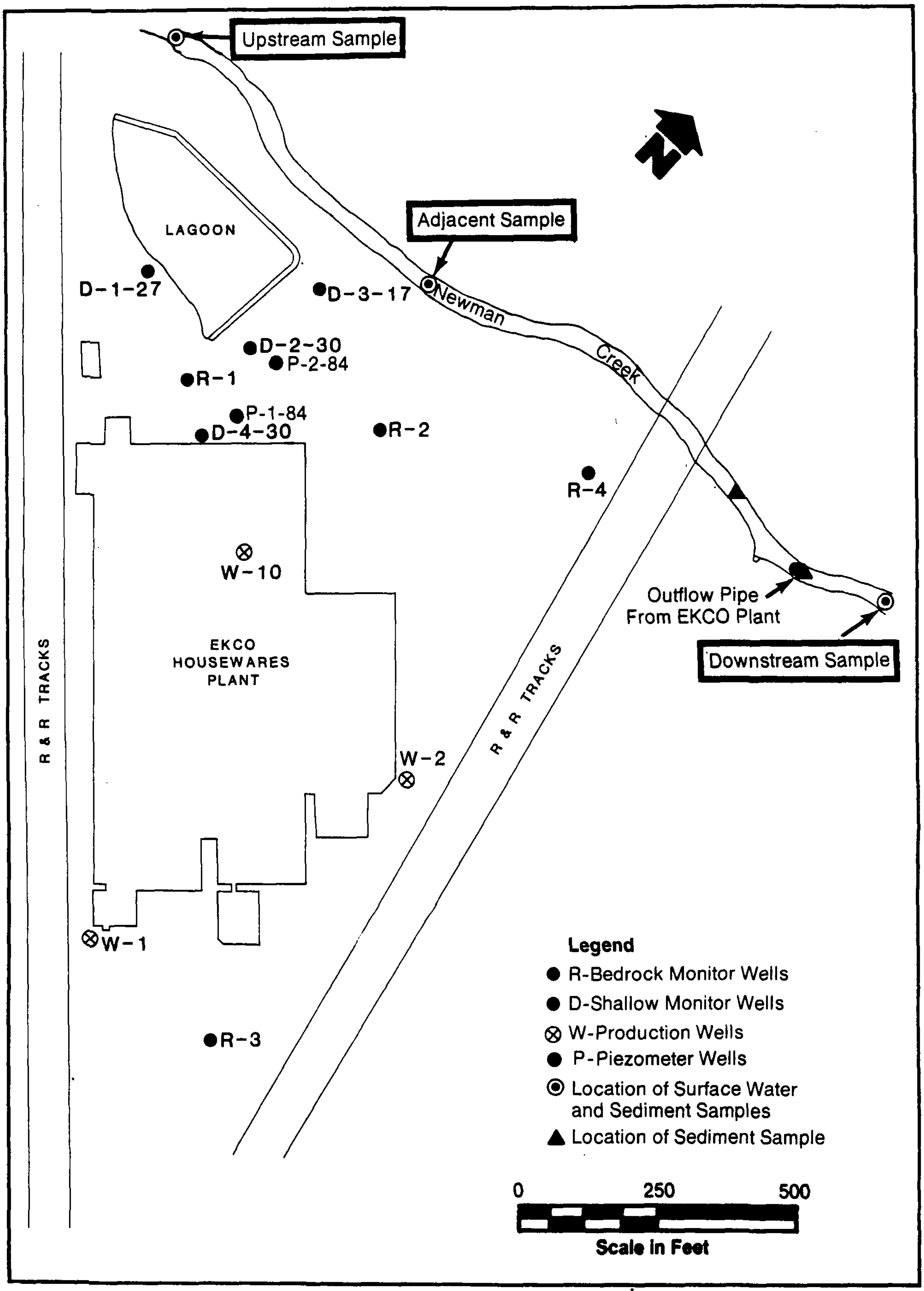


FIGURE C-1 LOCATIONS OF SURFACE WATER AND SEDIMENT SAMPLES EKCO HOUSEWARES, INC, MASSILLON, OHIO

TABLE C-1

SUMMARY OF SURFACE WATER SAMPLING

Parameter	Approximate No. of Samples	No. of QA Samples Trip	No. of QA Samples Duplicate	Approximate Total No. of Samples	Bottle Type	Preservative
HSL VOC	3	1	1	5	(2) 40 ml vials	Cool, $4^{\circ}C$
CLP Metals (Total)	3	--	1	4	(1) IL Poly	HNO_3, to pH < 2 Cool, $4^{\circ}C$
Total Cyanide	3	--	1	4	(1) IL Poly	NaOH to pH > 12 Cool, $4^{\circ}C$

distance. The velocity will be measured near the upstream sample location and near the downstream location. The information will then be recorded into the field log book.

(12) At one downstream location, a cross sectional area will be measured so that total flow can be estimated. Outflow from the EKCO plant will be measured at the same time.

APPENDIX D

STREAM SEDIMENT SAMPLING

APPENDIX D

STREAM SEDIMENT SAMPLING

(1) Five (5) stream sediment samples will be collected from Newman Creek at the locations shown in Figure C-1 of Appendix C. Three of these locations will be taken at the same point as the surface water samples. Two additional samples will be taken at locations between the adjacent and downstream samples and directly upstream and downstream of the plants' outflow pipe.

(2) The stream's sediments will be sampled in a downstream to upstream fashion. The sampler will stand downstream of the sampling point while collecting the sample.

(3) The sediments will be collected using pre-cleaned, dedicated stainless steel trowels from the top 1 to 2 centimeters of deposited material.

(4) The collected sediments will be placed into a pre-cleaned, dedicated stainless steel bucket and then will be sieved through a size 10 pre-cleaned, dedicated stainless steel sieve into another pre-cleaned, dedicated stainless steel bucket to remove larger pebbles, rocks and organic debris.

(5) The samples will be placed in the sample containers specified on Table D-1. The samples will be analyzed for HSL VOCs, metals and cyanide.

(6) All pertinent information will be recorded in the field log book (time of collection, physical characteristics of the sample, etc.).

(7) A VOC field water blank will be prepared for each day of shipping.

(8) A duplicate sample will be taken at the downstream location.

(9) The samples will be prepared for shipment (placed in vermiculite-filled coolers with chain-of-custody seals) and will be entered on a chain-of-custody form.

TABLE D-1

SUMMARY OF STREAM SEDIMENT SAMPLING

Parameter	Approximate No. of Samples	No. of QA Samples Trip	Duplicate	Approximate Total No. of Samples	Bottle Type	Preservative
HSL VOC	5	1	1	7	(2) 120 ml glass	Cool, 4°C
HSL Metals	5	--	1	6	(1) 8 oz. glass jar*	Cool, 4°C
Cyanide	5	--	1	6	(1) 8 oz. glass jar*	Cool, 4°C

* CN and metals analyzed from one (1) 8 oz. jar

APPENDIX E

SOIL GAS PROCEDURES

APPENDIX E

SOIL GAS PROCEDURES

(1) Soil gas samples will be collected at the locations already identified as potential point sources at a 50-foot grid spacing. Grid spacing will be modified accordingly, depending upon the distribution of the volatile organic compounds obtained in the field. It is anticipated that the sampling program will consist of approximately 100 to 150 sampling sites.

(2) Samples will be obtained by hard driving small diameter (3/4-inch) steel probes with microporous tips to depths of 3 to 5 feet and aspirating gas through the probes using a battery-powered air pump.

(3) After a purge time of approximately five minutes, each sample will be collected through an in-line "T" fitting into a clean syringe. (Each syringe will be purged before sampling by heating in the gas chromatigraph (GC) oven to prevent any cross-contamination).

(4) A duplicate sample will be collected at a select location in each potential point source area.

(5) All appropriate information such as sampling time, sample number, location, sampling depth and evacuation time before sampling will be entered into the field log book.

(6) The soil gas samples will be analyzed in the field using a mobile GC unit with an appropriate detector specific to the target compounds. Because TCA and TCE have been identified at the highest levels in ground water samples from the site, these two compounds will be considered the target compounds, and an electron capture detector and appropriate standards will be utilized.

(7) Detection limits will depend upon the interferences from other compounds present in the soil gas.

(8) Quantifications of the target compounds will be accomplished by the external standard method, with calibration check standards being run at least four (4) times daily.

(9) All samples will be run in duplicate, usually at different sample volumes. Air, nitrogen, and hexane blanks will also be run frequently to check for and to minimize the effects of carryover or cross-contamination between separate runs.

(10) It is anticipated that approximately 15 samples will be collected and analyzed each day.

(11) Each sample probe will be used only once daily and will be decontaminated by washing them in Alconox and tap water followed by steam cleaning.

APPENDIX F

SOIL BORING PROTOCOL

APPENDIX F

SOIL BORING PROTOCOL

(1) The locations of the soil borings will be staked and then approved by representatives of EKCO.

(2) An auger rig will be utilized for the installation of the soil borings. All downhole drilling equipment will be steam cleaned prior to advancing each hole.

(3) Soil samples will be collected continuously with decontaminated sample drivers. The sample drivers will be decontaminated before collecting samples for stratigraphic analysis by rinsing with Alconox and tap water. Sample drivers used to collect samples for chemical analysis will be decontaminated by rinsing with Alconox in tap water followed by steam cleaning.

(4) An HNu and PID will be used to detect any volatile organics as the sample driver is opened.

(5) A description of the sample will be recorded in the field log book including the information described in Appendix B, Step 5.

(6) Representative samples of each type of lithology will be collected for stratigraphic evaluation and will be retained in clean, wide-mouth sampling jars.

(7) Samples from each boring for chemical analysis will be collected from depths of 0 to 2 feet, 4 to 6 feet and 8 to 10 feet below ground surface or at the discretion of the on-site geologist based on vapor detection, discoloration or other field indicators.

(8) The samples will be transferred into the sample bottles specified in Appendix D, Table D-1. The samples will be analyzed for HSL VOCs, metals and cyanide. All information will be recorded in the field log book.

(9) The soil borings will extend to the top of the water table.

(10) A trip blank will be prepared for each day of shipping.

(11) A rinse blank will be prepared after sampling the last boring.

(12) A duplicate sample will be taken for every ten (10) samples collected.

(13) Upon completion, the borehole will be grouted to the surface with a grout mixture of 1 part of sodium bentonite powder to 2 parts of portland cement.

(14) The cuttings from the borings will be stock piled, pending disposal, on plastic-lined sheets and then covered.

APPENDIX G

GROUND WATER SAMPLING PROTOCOL

APPENDIX G

GROUND WATER SAMPLING PROTOCOL

G.1 MONITORING WELL SAMPLING (I-2 THROUGH I-8, L-1 THROUGH L-5, S-7, D-4-30, R-1 THROUGH R-5, W-2 AND OHIO WATER SERVICE WELL NO. 4)

(1) All downhole equipment (pumps, bailers, etc.) will be decontaminated prior to use by:

- o Washing with Alconox and tap water
- o Rinsing with tap water
- o Rinsing with distilled water

(2) The wells will be unlocked and the head space monitored with an HNu or PID.

(3) The static water level and total depth of the well will be measured to the nearest 0.01 foot and recorded.

(4) The minimum number of gallons to be purged will be calculated by multiplying the length of the water column by 0.65 (4" well), 1.02 (5" well), 0.37 (1 1/2" well), or 5.88 (12" well). This represents one well volume. A minimum of three volumes will be purged. The data will be recorded in the field log book.

(5) The amount of water calculated in Step 4 will be removed by setting the pump intake approximately five (5) feet below the top of the water column, starting the pump, and lowering the pump as the water level drops.

(6) The purge water will be discharged into a tanker and taken to the air stripper for processing.

(7) The wells will be allowed to recover to approximately 75 percent of the initial static water level.

(8) The samples will be collected using a bottom filling teflon bailer and dedicated nylon rope and transfered into pre-labeled bottles.

(9) The sample for HSL volatile organic compounds (VOCs) will be collected first, followed by a sample for field parameters (pH, temperature, and specific conductivity) for immediate analysis and finally the samples for metal and cyanide analyses.

(10) All pertinent information will be recorded in the field logbook (time of collection, field parameter data, physical characteristics of the sample, etc.).

(11) The sample for metal analysis will be filtered and then preserved with HNO_3 to a pH of below 2. The sample for cyanide analysis will be preserved with NaOH to a pH of above 12.

(12) A trip blank will be prepared for each day of shipping.

(13) A rinse blank will be prepared after sampling the last well.

(14) A duplicate sample will be taken for every ten (10) samples collected.

(15) Table G-1 contains a summary of the monitoring well, production well and Ohio Water Service Well No. 4 sampling.

(16) The wells will be relocked.

(17) The samples will be prepared for shipment (placed in vermiculite-filled coolers with chain-of-custody seals) and will be entered on a chain-of-custody form.

G.2 PRODUCTION WELL SAMPLING (W-1 AND W-10)

(1) The static pumping water level and the total depth of the well will be measured.

(2) The samples will be collected directly from the well tap into the sample bottles specified in Table G-1. The discharge water will periodically be monitored with an HNu and PID during sample collection.

(3) The sample for HSL VOAs will be collected first, followed by a sample for field parameters (pH, temperature, specific conductivity) for immediate analysis. This data will be recorded into the field log book. The samples for metals and cyanide analyses will then be collected.

(4) The samples for metals and cyanide will be prepared in the same manner as stated in G.1, Step 11.

(5) The QA/QC samples will be taken in the same manner as stated in G.1, Steps 12-14.

(6) The samples will be packaged and shipped as stated in G.1, Step 17.

TABLE G-1

SUMMARY OF MONITORING WELL, PRODUCTION WELL* AND
OHIO WATER SERVICE WELL NO. 4 SAMPLING

		No. of QA Samples					
Parameter	No. of Samples	Trip	Rinse	Duplicate	Total No. of Samples	Bottle Type	Sample Preservative
HSL VOC's	23	3	1	2	29	(2) 40 ml vial	Cool, $4^{o}C$
CLP Metals (Dissolved)	23	--	1	2	26	(1) IL Poly (for collecting) (1) IL Poly (for filtered sample)	Field Filter then HNO_3 to pH <2 Cool, $4^{o}C$
Total Cyanide	23	--	1	2	26	(1) IL Poly	NAOH to pH >12 Cool, $4^{o}C$

* Wells to be sampled are I-2 through I-8, L-1 through L-5, S-7, D-4-30, R-1 through R-5, W-1, W-2 and W-10.

Metcalf & Eddy
Hazardous Waste
Management Division

6480 BUSCH BOULEVARD
SUITE 120
COLUMBUS, OHIO 43229
TELEPHONE (614) 436-5550

January 18, 1988

Draft

Mr. Dean Geers
Jacobs Engineering Group
222 S. Riverside Drive, Suite 1870
Chicago, Illinois 60604

Subject: Review Comments, Ground Water Assessment Plan at the Ekco Housewares Facility, Massillon, Ohio
Contract #68-01-7351
W.A. 483

Dear Mr. Geers:

We have completed our review of the Ekco Housewares Ground Water Assessment Plan. Enclosed please find our review comments on the above referenced document.

Today's submittal partially completes our Work Plan Deliverable 5 - "review of additional plans on reports", as established in Jacobs Engineering Group's, Inc. TES IV Contract #68-01-7351.

Please forward these documents to Mr. Walter Nied of the U.S. EPA, Primary Contact of W.A. 483.

Sincerely,

G. R. Myers
Work Assignment Manager

GRM:gem

cc: J-file

Metcalf & Eddy
Hazardous Waste
Management Division

6480 BUSCH BOULEVARD
SUITE 120
COLUMBUS, OHIO 43229
TELEPHONE (614) 436-5550

January 18, 1988

Mr. Walter Nied
RCRA Enforcement Section
U.S. EPA Region V
230 South Dearborn Street
Chicago, Illinois 60604

Subject: Ground Water Assessment Plan, Ekco Housewares
TES Work Assignment No. 483

Dear Mr. Nied:

Enclosed please find technical review comments regarding the above referenced documents. I hope that the comments meet your needs. Please feel free to call upon me for additional clarifications.

Sincerely,

G. R. Myers
Work Assignment Manager

GRM:gem

cc: J-File
Dean Geers (w/enclosures)
J. Strayton
T. Struttmann
S. Norris

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT HAZARDOUS WASTE SITES

TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. 483

TECHNICAL REVIEW COMMENTS ON THE GROUNDWATER ASSESSMENT PLAN

AT

EKCO HOUSEWARES FACILITY
MASSILLON, OHIO
U.S. EPA REGION V

JACOBS ENGINEERING GROUP, INC.
PROJECT NO. 05-B635-00

WORK ASSIGNMENT PERFORMED BY:

METCALF & EDDY, INC.
6480 BUSCH BOULEVARD, SUITE 120
COLUMBUS, OHIO 43229

JANUARY 18, 1988

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1.0 INTRODUCTION

U.S. EPA has entered into a Consent Agreement with Ekco Housewares, Inc. under Section 3008(h) of RCRA in 1987. This action requires Ekco to conduct a RCRA Facility Investigation, Corrective Measures Study, and Corrective Measures Implementation (RFI/CMS/CMI) at their Massillon, Ohio facility. A corrective action alternative will be selected by U.S. EPA and implemented by Ekco at the completion of the RFI/CMS.

U.S. EPA has requested that the TES Contractor represent U.S. EPA and provide assistance in monitoring and inspecting any RFI/CMS/CMI work performed on-site, provide professional technical support personnel to review the Corrective Action Plan, draft and final RFI, CMS, CMI reports, and conduct an independent, preliminary hydrologeologic assessment of the Massilon, Ohio area.

Pursuant to the Consent Agreement and implementation of the RFI/CMS, Weston, Inc., on behalf of Ekco Housewares, submitted a Groundwater Assessment Plan to address groundwater conditions at the Ekco facility.

The plan contained the following sections:

- 1 - Introduction
- 2 - Environmental Setting
- 3 - Ground Water Assessment
- 4 - RCRA Closure Monitoring Plan
- 5 - Corrective Action Analysis
- 6 - Schedule

2.0 GENERAL DESCRIPTION/ GENERAL COMMENTS

The Ekco Housewares facility is in the eastern part of Massillon, on the USGS 7 1/2 minute, Massillon Quadrangle Stark County, Ohio - T10N, R9W (Figure 1). The area of concern is located due north of the juncture of the Penn Central and Baltimore and Ohio Railroads, south of Kelso Creek, and west of the Tuscarawas River. It is occupied by the Ekco Housewares, in Massillon, Ohio Plant, Massillon Division. The address is 359 State Avenue Extension N.W., Massillon, Ohio.

The reasons for concern in this area are that hazardous organic compounds have been detected in the groundwater. The source of the contamination is not yet known; however, the hazardous compounds are chlorinated organic solvents and their degradation products. The major reason for concern is the location of the contaminated groundwater with respect to the Massillon municipal well field. The Massillon municipal wells are owned and operated, under contract, by the Ohio Water Service Co. One well has already been abandoned because of contamination by the organic solvents and their degradation products. It is essential to prevent this contamination from reaching other city wells or private wells in the area.

The suspected source of contamination is located in an industrial and residential area about two-thirds of a mile west of the Tuscarawas River. Ekco Housewares, Inc. is one facility in the area known to have used the contaminants found in the groundwater, and is suspected of having released them to the environment.

Ekco Housewares maintained and operated an industrial waste water treatment lagoon until 1985. Approximately 200,000 gallons per day of industrial process waste water laden with the contaminants discharged to the lagoon with no surface discharge recorded from the lagoon. This indicates that the majority of the contaminated waste water was percolating through the lagoon bottom and into the groundwater at the facility.

The concentrations of some of the contaminants are so high in the groundwater in some areas at the Ekco facility that they approach their respective solubility limits in water. This is a serious problem because of the potential for contaminant migration in the groundwater as free product along zones or surfaces of low permeability.

In communications with Mr. Rodney Beals of the Ohio EPA, Ekco has acknowledge that several "spills" of the contaminant raw products may have occurred and gone unreported by employees at Ekco. These spills may be reflected by the high concentrations of contaminants seen in the groundwater at the Ekco facility.

It is common knowledge in the chemical waste industry that TCE and 1,1,1-TCA degrade through physical, chemical, and biological action to less chlorinated hydrocarbon species. The end product of may of these processes in vinyl chloride and trichloroethene are 2.0 ppb and 5.0 ppb. However, the recommended maximum contaminant level for both of these compounds is 0. As TCE and 1,1,1-TCA degrade, a corresponding increase in the other chlorinated degradation species will take place, such as is seen to occur at the Ekco facility.

The Ekco plant has been in operation from at least 1945 with current manufacturing processes continuing since that time. The plant has interim status under RCRA Hazardous Waste Management Regulations to generate and store hazardous waste. Additionally, the facility has an Ohio NPDES permit to discharge industrial waste water to Newman Creek and the Tuscurawas River.

3.0 TES-IV CONTRACTOR REVIEW COMMENTS

This section contains the TES Contractor's comments on the sections listed above.

Review Comments: Section 1 - Introduction

1. Introduction, page 1-1, paragraph 1: The last sentence should indicate that the "evaporation pond" was a process waste water infiltration and evaporation pond.

2. Page 1-1, paragraph 2: The last sentence does not belong in this section because this section does not address corrective measures technologies. The "no-action" alternative given here "natural flushing of the soils..." is inappropriate because of documented offsite contaminant migration. It should be removed.

3. Page 1-1, paragraph 3: The first sentence should be changed from "...closure plan for the evaporation lagoon facility..." to "...closure plan for the waste water pond...".

4. Page 1-2, paragraph 1: One of the six objectives of the plan, listed on p. 1-2, is to define ground-water flow directions. In the plant area this has already been determined reasonably well, where the direction of movement is controlled by the cone of depression caused by the remedial pumping of well W-10. What is needed is information on groundwater movement outside this cone, between the plant and public supply wells 1, 2,

2,000

and 3, located about ~~2,000~~ feet northeast of the plant. The TES Contractor recommends that monitoring well clusters be installed between the Ekco facility and OWS wells 1,2, & 3.

5. Page 1-2, paragraph 1: Is the fourth item listed in this paragraph an objective of the overall RFI/CMS or the Groundwater Assessment.

6. Page 1-2, paragraph 3: The report states that a "wide variety of businesses operate in the vicinity of the Ekco plant". They list half a dozen businesses, none of which would likely generate much industrial waste, and none of which appear on the one-mile radius map, Figure 11. None of the three businesses that do appear on Figure 11 are listed, nor is anything said about them. Are any of them known generators of industrial wastes?

7. Page 1-1, paragraph 5: The site should be surveyed so that reference points and elevations are expressed with respect to an established National Gedoetic Vertical Datum (NGVD) and all water level measurements should be taken to .01 foot, as indicated in the Technical Enforcement Guidance Document (TEGD; September 1986).

8. Page 1-4, paragraph 3: What were the new regulations and permit requirements referred to in the second sentence?

9. Page 1-4, paragraph 4: What pollutants were covered by the NPDES permit? What was/were the discharge limits of the permit?

10. Page 1-5, paragraph 2: Was the lagoon operated under permit when it was brought back on-line from 1980 thru 1985? Provide details on the permit type, number, conditions, etc. if applicable.

11. Page 1-5, paragraph 5: Are the test holes and piezometers sealed below their respective water level? Additional details about well and test hole construction should be provided in this section.

12. Page 1-8, paragraph 2: The numerous references in this report to closure of the "evaporation lagoon" are puzzling. The last paragraph on p. 1-1 seems to say that the discussion of curcial parts of the hydrology, those relating to infiltration through the ground and into Newman Creek (if we have deciphered it correctly) will not be given here, but will be addressed in a forthcoming report on the "groundwater assessment for the evaporation lagoon".

13. On p. 1-8, paragraph 2: Apparently, the infiltration/evaporation lagoon was taken out of service in December 1985, and subsequently pumped (or siphoned) dry. In June 1986, Floyd Brown Associates installed several test borings (four in the bed of the dry lagoon) and developed a "preliminary closure plan". The test borings are shown in Figure 4, referred to as "phase I soil borings". In July 1987, Weston was contracted to begin "development for a final closure program for the lagoon". Nothing more is said about all this, but evidently more drilling was done. Figure 5 shows the location of 19 additional soil borings in the lagoon evidently done by the Floyd Brown firm as part of "phase II soil borings". It is interesting to see that so many borings would be deemed

necessary in such a small place. Nineteen soil borings, in addition to those collected during "Phase I", is an excessive number of borings. These borings should have been located elsewhere on the facility property. One wonders what they were looking for?

14. Page 1-23, paragraph 1: In the third item listed, there is no way for Weston to know whether all water wells were identified within a one mile radius.

Review Comments: Section 2 - Environmental Setting

1. Regional Geology, page 2-1: Descriptions of the regional geology are very poor. Where in northeast Ohio is the valley fill 500 feet thick? Where is the reference for the statement concerning the valley fill. And where, too, is the reference for the statement relative to the regional dip? It may indeed range between 20 and 40 feet per mile, but how does Weston know? And how about "occasional" limestone units; one day you see them and the next day you don't? Weston means "interbedded limestone units" here and should state it as such.

2. Page 2-1, paragraph 1: The description of the regional geology seems to disregard the significant outwash valleys. A brief discussion of their impact on the regional geology should be included in this section.

3. Page 2-7, paragraph 2: Weston says that the Tuscarawas Valley contains as much as 285 feet of unconsolidated material, and tributary valleys have up to 270 feet of material in them. Drift thickness maps of the Ohio Division of Geological Survey show a little over 200 feet of fill in the Tuscarawas Valley and much less in

tributary valleys. Where did Weston get this information? Further, Weston says that drilled wells in this area range in depth up to 500 feet; is Weston talking about water wells?

4. Page 2-9, paragraph 3: Are the wells adequate to use for measuring the groundwater elevations in, and the vertical head difference between the sandston and outwash aquifers?

5. Page 2-9, paragraph 4: It is assumed that where Weston says the gradient is obscured by the cone of the depression shown in Figure 12, they mean the regional gradient.

6. Page 2-13: Weston states that the unconsolidated sediments and the "Pottsville Sandstone" (Weston means Sharon Sandstone) "function as two separate hydrologic units". Weston doesn't really believe this for on p. 3-1 Weston talks about ways to assess the "hydrologic interconnection" between them.) On p. 2-13, Weston goes on to say that ground-water flow in the unconsolidated sediments appears to be southeast towards the Tuscarawas River, a statement based, no doubt, on the contours on Figure 13. A study of Figure 13 will show:

   a. The direction of movement in the vicinity of the lagoon is southeast, as Weston states, but not, as Weston suggests, in response to the regional gradient but very probably in response to the cone of depression around well W-10 (see Figure 12).

   b. There are no data points on Figure 13 to justify extending the contours beneath, and perpendicular to, Newman Creek. The TES Contractor contends that additional data would show the contours to curve southward around well W-10, to replicate the cone of depression in the Sharon Sandstone (see Figure 12). Thus, the contours would lie parallel with Newman Creek, consistent with the possibility that recharge is being induced from the stream.

c. There are no water-level data points in the unconsolidated sediments east, west, and south of well W-10; the TES Contractor believes such data would show conclusively that groundwater levels in the unconsolidated sediments conform generally to the pumping cone in the sandstone. With this in mind, the TES Contractor suggest the installation of additional shallow monitor wells north and east of the plant to augment those already proposed for the locations shown in Figure 14.

Figures and Tables

1. At our November 24, 1987 conference the TES Contractor and the U.S. EPA made a plea that well and groundwater elevations be referenced to sea level in the reports and plans. Ekco Co. representatives agreed.

2. Figures 8 and 9: The TES Contractor disagrees with the cross sections, Figures 8 and 9. In Figure 8, the Sharon Sandstone is broken into two units, a sandstone above and "alternating layers of shale and sandstone" below. Both of these disappear on Figure 9, where we have sandstone "interbedded with thin lenses of shale". Whomever "generated" (see 2-1) these cross sections for Weston never looked at them side by side.

Also why did the "clay, stones" at well R-4 in Figure 8 change to "clay, sand and gravel" at the same well in Figure 9? The "clay, stones" layer in Figure 8 suggests glacial till. White's glacial map (Bull. 61, Geology of Stark Co.) shows only sand and gravel and allivium in the plant area.

Review Comments: Section 3 - Ground Water Assessment

1. Page 3-1, paragraph 3: Weston proposes a pumping test to determine "transmissivity, flow directions, and hydraulic gradient". It is not clear how a 48-hour cessation of pumping in well W-10 (after which pumping is to be resumed) will add much practical knowledge of flow directions and hydraulic gradient. Normal regional gradients probably won't be re-established in 48-hours, certainly not if the public supply wells continue to be pumped.

   Weston evidently believes (see item 9, p. A-1 of the Groundwater Assessment Plan) that they can determine the transmissivity of both the sandstone and the unconsolidated deposits by pumping a well in the sandstone. This simply is not possible.

   Although in a situation like this a pumping test is considered "scientific", and almost mandatory, the TES Contractor believes that the data from the proposed test will be so hard to interpret that any and all results will be suspect. Consider the problems:

   a. First, we have a heterogeneous aquifer; there are numerous shale interbeds and markedly different levels at which the driller reported "most water pickup" in the test wells. Second, the wells are near the edge of the sandstone aquifer, where it thins and eventually terminates at the edge of the buried valley. Will the outwash deposits in the buried valley act as a positive boundary?

b. Second, and promising to further complicate the test results, is the probability that leakage from the unconsolidated sediments into the sandstone will occur during the test. (If the TES Contractor's hypothesis relative to a cone of depression existing in the unconsolidated sediments is correct, leakage is certain to occur.) If it occurs, such vertical leakage won't be uniform. Some of it may follow down the bores of poorly-seated wells nor, because of anticipated head changes during the test, will it occur at a constant rate. It seems likely to that during early pumping the head in the unconsolidated deposits will decline, but eventually because of the discharge of the test well into Newman Creek, water probably will reenter the unconsolidated sediments by induced infiltration and raise the head, at least locally.

c. The TES Contractor recommends that the proposed test be less complicated than the above scenario suggests, and that a convincing value for aquifer transmissivity can be obtained. It should be remembered that if pumping is not held constant in the plant supply wells, interpretation of the data may be even more difficult than the TES Contractor has suggested.

d. It is not stated how the discharge from the pumping well will be measured. The TES Contractor assumes that Weston is aware of the necessity of accurately determining the discharge (such as by use of an orifice pipe and manometer) and in keeping the discharge constant. A fluctuating pumping rate will add even more problems in interpretation than those the TES Contractor has already mentioned. Also, a staff gage should be installed in Newman Creek and read periodically during the test. Changes in stream stage might affect water levels in nearby wells.

2. Page 3-1, paragraph 3: Pump testing the sandstone aquifer will probably have little impact on the outwash aquifer if they are two distinctly separate hydrologic units, as Weston indicates in the report.

3. Page 3-1, paragraph 4: The slug tests that are proposed here cannot be run with wells screened above the water table because the zone of aeration will be tested in addition to the water table. The values generated by this test would not reflect the true characteristics of the water table aquifer.

4. Page 3-1, paragraph 3: Slug tests are not adequate enough to judge the whole site. They only provide information on the aquifer characteristics in a very localized area around the well in question. Pump tests should be used instead of slug tests.

5. Page 3-1, paragraph 6, et. seq.: The sandstone unit that Weston refers to in the text is the Sharon Sandstone (Bulletin 61, Division of Geological Survey) not the Pottsville Sandstone.

6. Page 3-2, paragraph 1: An additional monitoring well should be installed just north of well D-2-30 to replace the abandoned D-2-30 as a monitoring point.

7. Page 3-2, paragraph 2: An additional monitoring well should be installed into the outwash aquifer adjacent to the "south well" - well W-1. This should be done so that a monitoring well in the outwash aquifer is located on the south side of the plant. Additionally, since contamination has been found in bedrock well W-1, the outwash aquifer should be monitored in the immmediate vicinity of well W-1.

8. Page 3-2, paragraph 3: Three of the four offsite monitoring wells indicated in the plan are single wells not clusters. These should be monitoring well clusters that screen the entire thickness of the outwash aquifer, including the bedrock interface. Because the concentration of some of the contaminants have approached their solubility limits in the groundwater, free phase migration of these contaminants may occur along discrete planes of low permeability in the outwash aquifer.

9. Page 3-2, paragraph 1: No proposed monitoring wells are located north-northeast of the Ekco facility, between Ohio Water Service wells 1, 2, and 3. At least two well clusters should be placed between the facility and the municipal wells as both early warning and intercept wells.

10. Page 3-2: Consider screening the bedrock interface as well.

11. Page 3-2, paragraph 3: What about phased installation of the wells as an option? Run groundwater and plume models prior to installation.

12. Page 3-2, paragraph 3: Only one monitoring well cluster (2 wells), located due east of the facility, was proposed in this plan. There should be at least two additional monitoring well clusters located between the plant site and OWS wells 1, 2, and 3 to detect any contamination migrating toward the municipal wells. The well clusters should screen the entire thickness of the glacial outwash and the bedrock interface. These and all monitoring wells must thoroughly characterize and define the horizontal and vertical boundaries of the contaminant plume, as indicated in the Technical Enforcement Guidance Document (TEGD; September 1986).

13. Page 3-4, paragraph 2: Should the last sentence be worded "...upstream... downstream of the lagoon area". Additionally, the surface water sample locations are not indicated on a map in this section. Move the map from the appendix to page 3-5, the first page after it is referenced in the text.

14. Page 3-4, paragraph 2: Where are the stream water samples located with respect to the lagoon discharge? What is the justification for their locations?

15. Page 3-4, paragraph 3: What is the justification for the stream sediment sample locations? As with the surface water samples, the sediment sample locations are not indicated on a map in this section. Also, one sediment sample should be taken at the Ekco outflow pipe.

16. Page 3-5, paragraph 2: Weston should establish a facility-wide grid, not just a localized grid, with contingencies to go to a smaller grid size in "hot" zones. A facility-wide grid eliminates the possibility

of overlaping sampling grids or of unsampled areas. Define what contaminant level indicates a "hot" point/area.

17. Page 3-5, paragraph 5: The TEGD (Sept. 1986) indicates that all "hot" areas should be sampled in addition to the thirteen (13) point sources. This will aid in characterizing the extent of the contaminant plume.

18. Page 3-7, paragraph 1: This whole paragraph warrants a discussion justifying the purpose and need for this sampling. Construction/installation details of this should be included here as well.

19. Page 3-7, paragraph 3: Monitoring wells and well clusters within the plume boundaries should be used to characterize the interior of the plume. In order to characterize the plume, monitoring well cluster may be necessary so that the entire thickness of outwash is screened, including the bedrock interface.

    The detection limit for all organic analyses being performed should be 1 ppb using ASTM purge and trap methods.

    All sampling data should be presented in tabular and x-y graphical forms for ease of interpretation. X-Y graphs should be presented as concentration of contaminants thru time.

Figures and Tables

1. Figure 14: Figure 14 is a very poor map in the TES Contractor's view, it would have been much more informative if the scale were smaller so that the river

and public supply wells could have been shown. If the supply wells were shown, the TES Contractor believes it would be evident that there is a need for monitor wells on the far side of Newman Creek. Sampling of such wells would show whether contaminants may have escaped from the immediate vicinity of the plant prior to the start of the remedial pumping. Also, groundwater levels north of the creek would help define the direction of movement in the unconsolidated materials.

2. Page 4-4, paragraph 1: No hydraulic information has been provided. A discussion of this topic should be included in this section.

Review Comments: Section 5 - Corrective Action Analysis

1. Page 5-1, paragraph 1: The TES Contractor takes exception to the first paragraph in Section 5 (p. 5-1) where it says, "Ground water modeling will be performed ... to evaluate the effectiveness of the on-going groundwater recovery program and air stripping activities relating to the removal of contaminants ...." Only field evidence can show how well the groundwater clean-up is proceeding; the computer won't tell you. Also, it seems that the long narrative in the rest of Section 5, explaining in needlessly complicated technical jargon how a model works, is designed not so much to inform but to bestow an odor of sanctity on a vague and unconvincing agrument that a computer model is absolutely necessary to this project.

   Assume that a computer model can be constructed that will replicate reasonably well the field data in the vicinity of the plant, in an area near the lateral limits of a rapidly thinning, heterogeneous sandstone aquifer overlain by a variable thickness of silt, clay, and outwash, just how useful would such a model be in predicting the direction and rate of movement of a contaminant that may have moved from the plant area into the very different hydrologic environment represented by the thick and highly permeable outwash aquifer in the Tuscarawas River Valley? Would Weston build another model, or would they put in a few wells and see what is really happening? Provide documentation supporting the use of the proposed modeling package(s), as indicated in the TEGD (Sept. 1986).

2. Page 5-1, paragraph 2: No preliminary modeling results are presented to justify monitoring well locations. Modeling should estimate rate, extent, and concentration of contaminants at different times and locations.

WADSWORTH
TESTING
LABORATORIES,
INC.

P.O. Box 208, 1600 Fourth Street, S.E., Canton, Ohio 44701 (216) 454-5809

REPORT OF ANALYSIS

Ekco Housewares
P.O. Box 560
Massillon, Ohio 44648

Attention: Mr. Leo Hahn

RECEIVED
MAY 22 1986
U.S. EPA, REGION V
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE ENFORCEMENT BRANCH

Sample Description: Water samples from Newman Creek

Laboratory I.D. Number: 92777

Date Sample Received: 11/6/85

Date of Report: 11/19/85

TOTAL DISSOLVED METALS

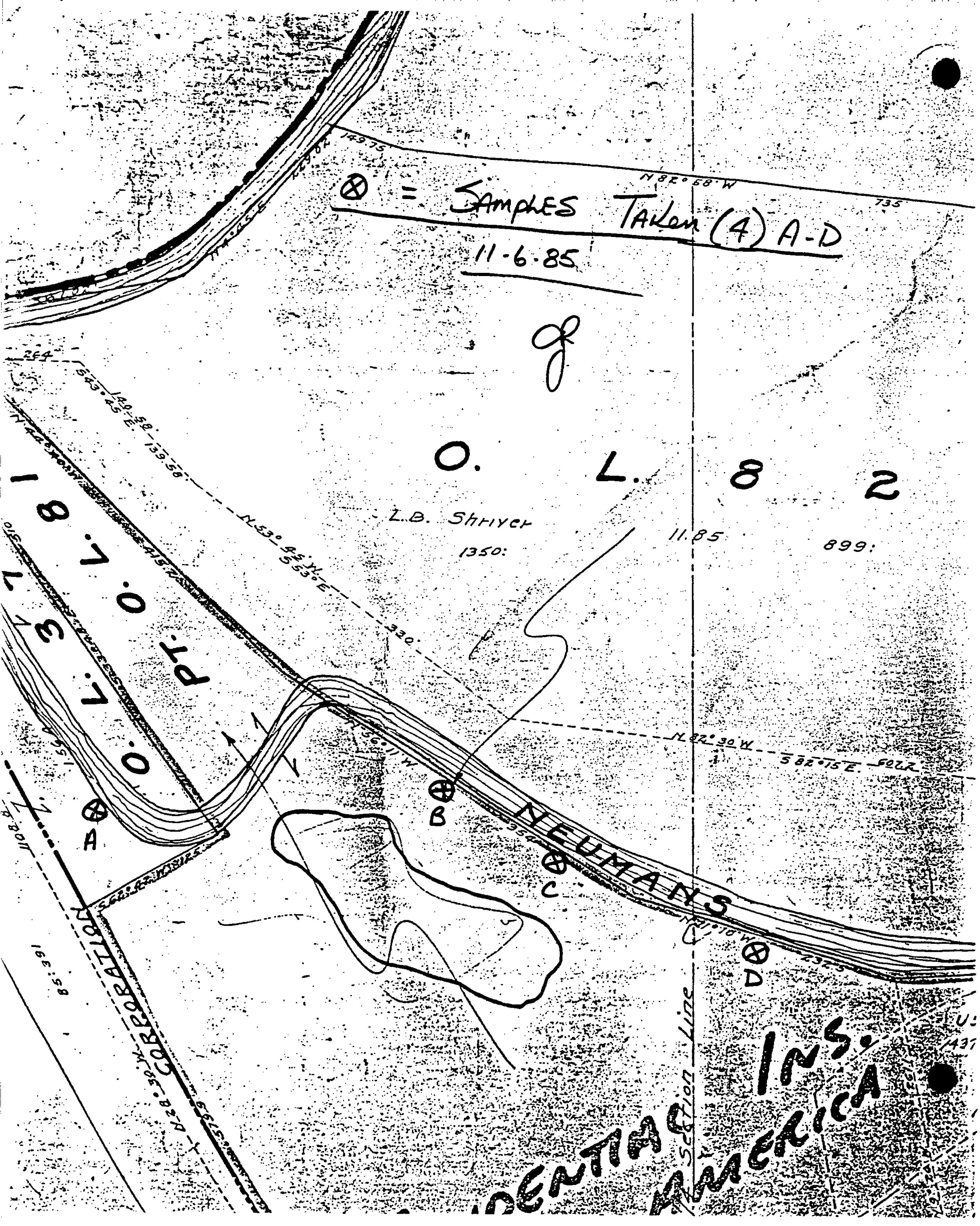
	Sample A	Sample B	Sample C	Sample D
Arsenic	<0.005 mg/L	<0.005 mg/L	<0.005 mg/L	<0.005 mg/L
Barium	<0.1	<0.1	<0.1	<0.1
Cadmium	<0.01	<0.01	<0.01	<0.01
Chromium	<0.02	<0.02	<0.02	<0.02
Hexavalent chromium	<0.02	<0.02	<0.02	<0.02
Lead	<0.05	<0.05	<0.05	<0.05
Mercury	<0.002	<0.002	<0.002	<0.002
Selenium	<0.005	<0.005	<0.005	<0.005
Silver	<0.01	<0.01	<0.01	<0.01

(Copy To T. Shingleton
J. Epps)

11/21/85

WADSWORTH TESTING LABORATORIES, INC.

Marvin Stephens
TPK



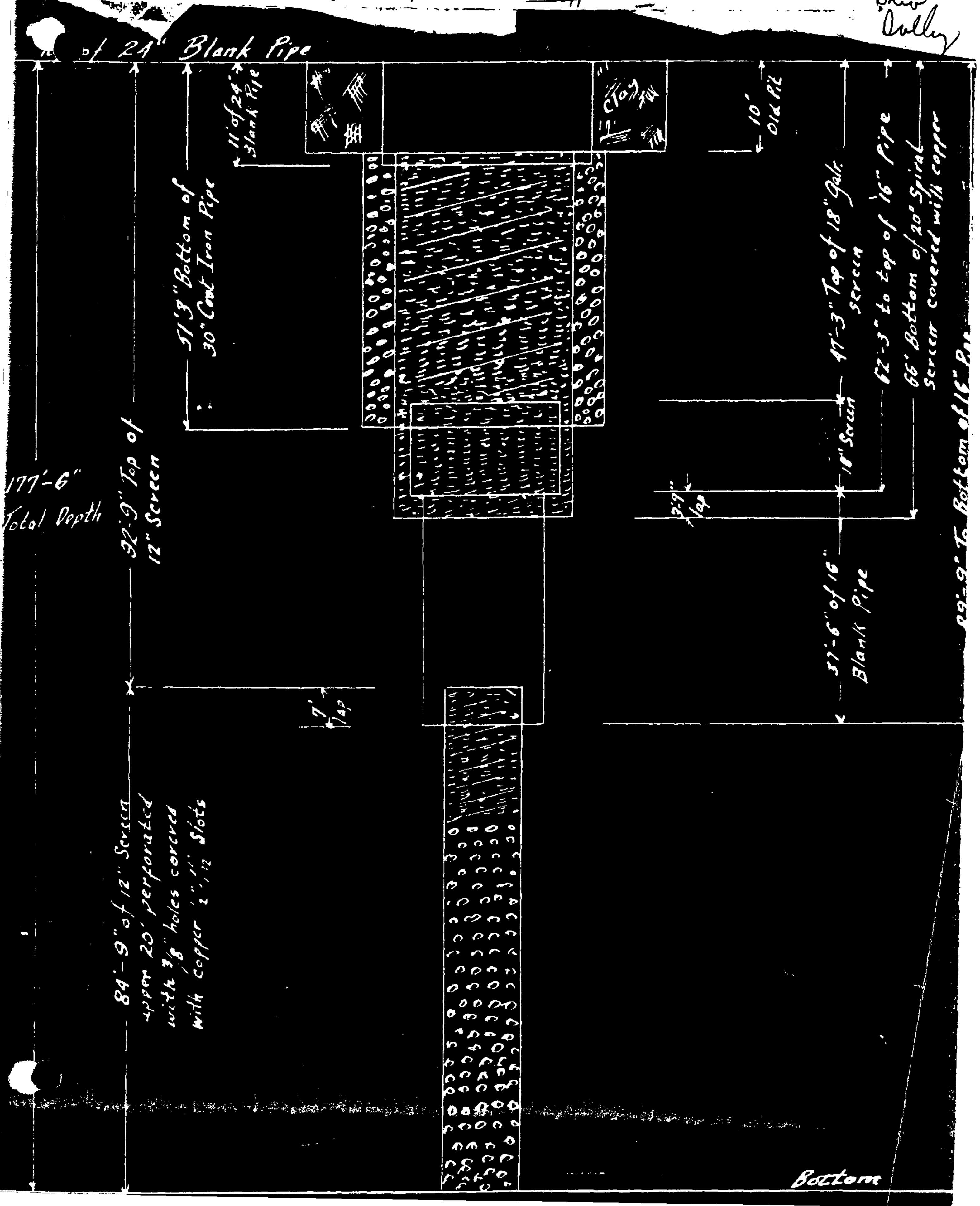
⊗ = SAMPLES TAKEN (4) A-D
11-6-85
O. L. 8 2
L.B. Shriver
1350:
11.85
899:
N 82°58' W
735
N 53°45' W
S 53° E
330
N 82°30 W
S 82°15 E
354
NEUMANS
A
B
C
D
PT. O.L. 7
CORPORATION
Section Line
INS.
AMERICA

#4

MASSILLON WELL #4

→ VINYL CHLORIDE 9.4 ppb

1-14-86 From Ohio Valley



LOG FOR #4 WELL

September 20, 1918.

6" Test well inside of large well at Massillon Pumping Station, south east corner of property along drive.

Depth of test taken.	
48 ft.	Sand and little clay and gravel (little water)
56 ft.	Sand with very little clay (water)
68 ft.	Sand, gravel and clay (no water)
78 ft.	Gravel and clay (no water)
88 ft.	Gravel and heavy clay, mostly clay (no water)
98 ft.	Sand and gravel with little clay (little water)
108 ft.	Sand and gravel with very little clay (more water, looks favorable at this point)
116 ft.	Sand and gravel (more water, looking good)
126 ft.	Sand and gravel (strong flow of water, gravel very loose and bails out good)
131 ft.	Same as test at 126 ft.
143 ft.	Same as test at 126 ft.

Samples taken at each test and delivered to office.

Test hole was stopped at 143 ft.

Theo Updegraff,

Driller.

Suggested Procedure for Removal of Volatile Organic
Chemicals from the Ground Water at
Ekco Housewares
Massillon, Ohio

The following procedure is subject to change as additional information is gathered during the investigative phase.

I Investigative Phase

1. Test holes will be drilled at the Ekco plant site to gather additional hydrogeologic information. Samples of the soils and ground water will be collected for chemical analysis.

2. The shape and size of the contaminant plume on the Ekco property will be determined.

3. A contour map of the piezometric surface will be drawn so that direction and velocity of ground water movement can be estimated.

4. Pumping data will be studied and a mathematical model of the wells will be developed so that the cone of depression produced by the plant's pumping can be approximated.

II Removal of the Contaminated Ground Water

1. If required, additional removal wells will be designed to pump the pollutant from the aquifer.

2. The site of the well or wells will be determined from the aquifer study and the location of the highest concentrations of the contaminant.

III Water Treatment Equipment

1. Water pumped from the removal wells will be treated to remove the VOCs before discharging to a stream.

2. If deemed necessary, a pilot air stripper will be erected to determine the design criteria for a permanent air stripper.

3. A consulting engineering firm will be hired to design the permanent equipment.

4. The Ohio Drilling Company will fabricate and erect the permanent air stripper.

5. The influent to the stripper and the discharge will be sampled at regular intervals to determine the efficiency of the tower.

Pollutants easy to strip.

IV Cleanup of the Aquifer

1. Water samples will be collected occasionally from the removal wells and water sample wells for chemical analysis.

2. The shrinking of the contaminant plume will be monitored.

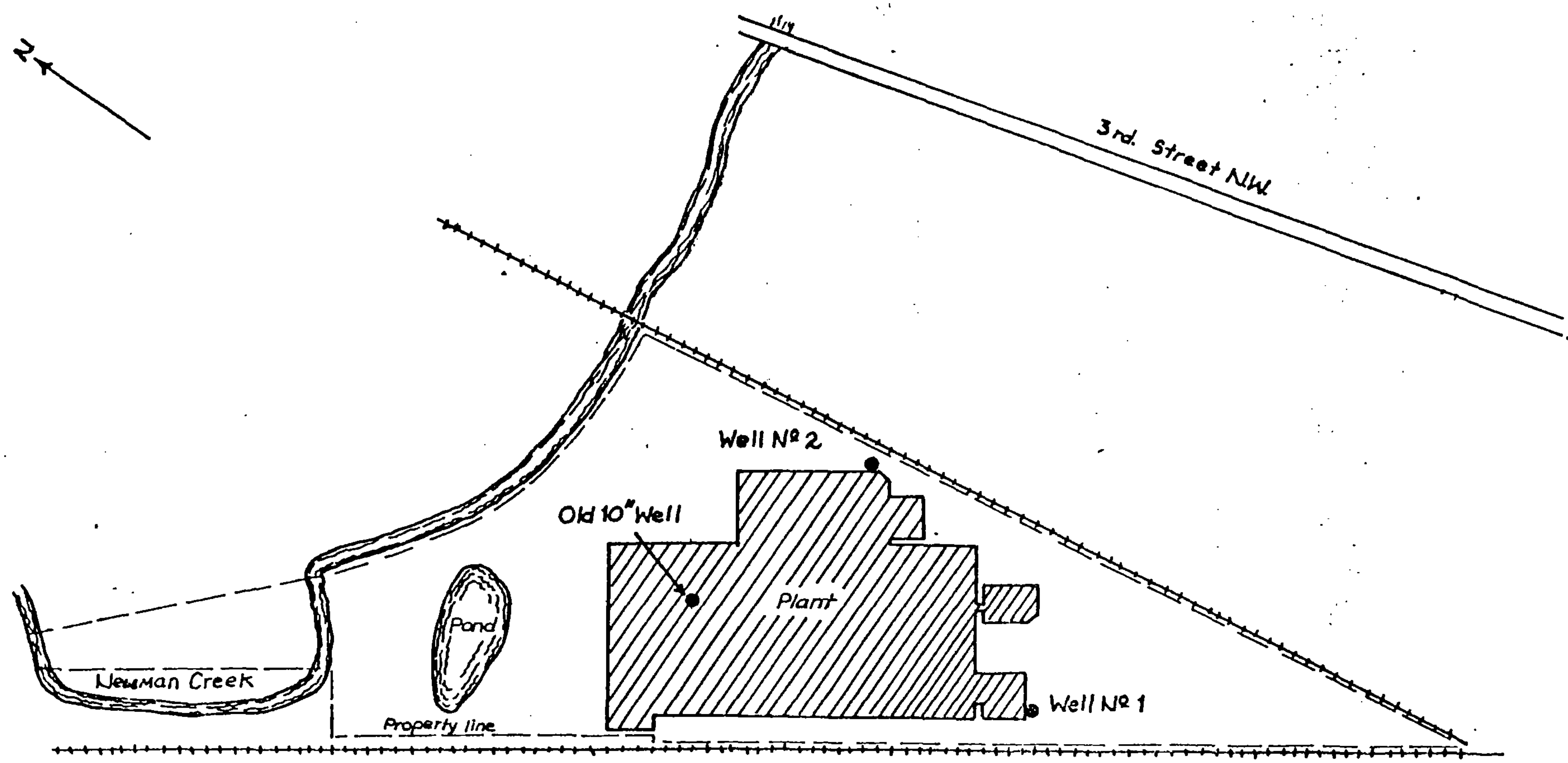
V Estimated Time to Complete the Work

1. It will take approximately four months to have an air stripper in operation.

2. The cleanup of the VOCs in the aquifer will take an extended period of time. The time required can be estimated after the investigative phase of the work is completed.

George H. Mayhew

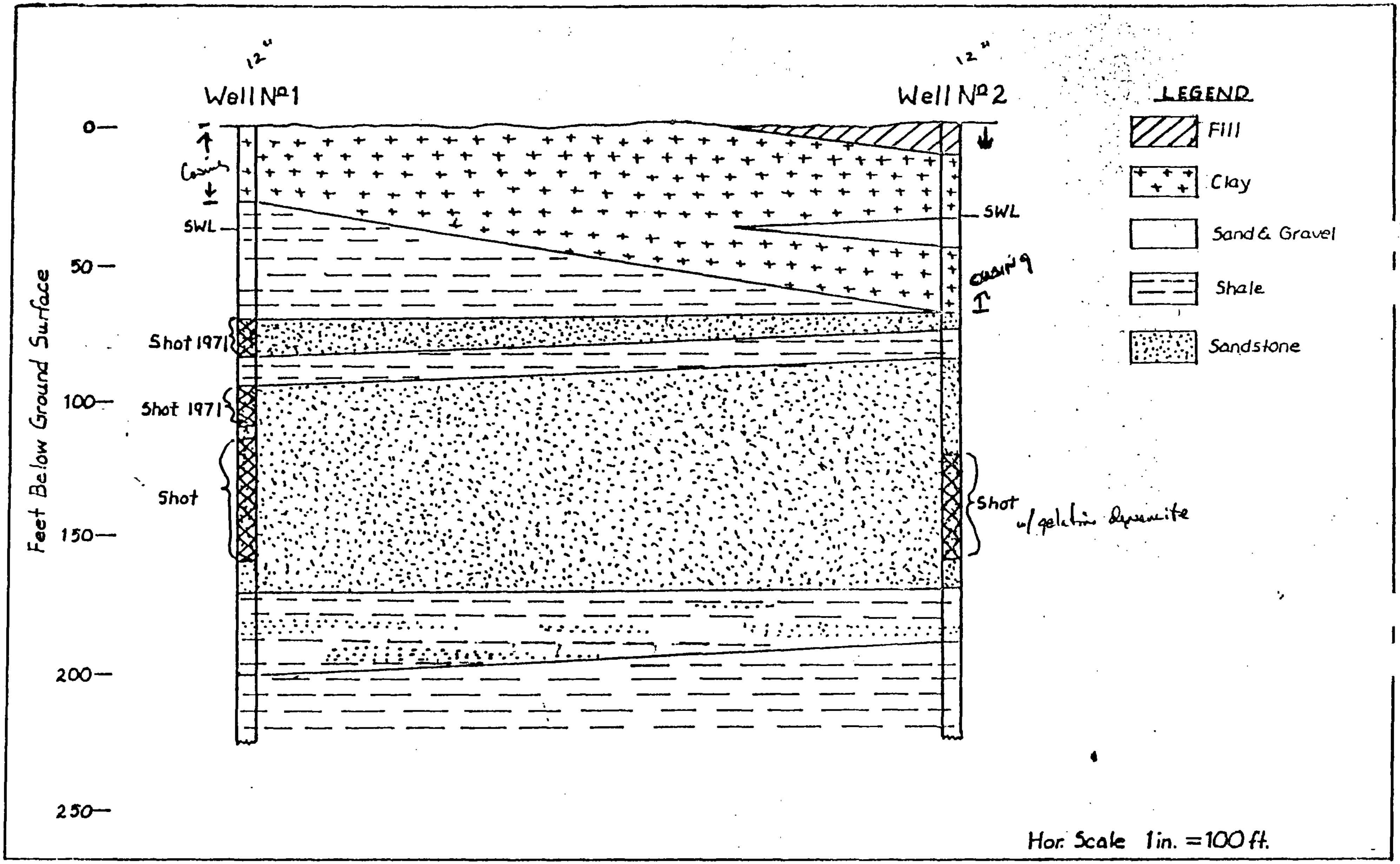
George H. Mayhew, Ph.D.
Certified Professional Geologist



LOCATION PLAT - Do Not Scale

1 in. = 300 ft.

EKCO HOUSEWARES COMPANY, MASSILLON PLANT SITE



<u>Geologic Cross-section SW-NE</u>

<u>EKCO HOUSEWARES COMPANY, MASSILLON PLANT</u>

THE OHIO DRILLING CO.
INCORPORATED
MASSILLON, OHIO

DRILLED FOR Massillon Aluminum Company, Massillon, Ohio HOLE NO. 1 - 12" Well

DRILLED BY Herb Dyer DRILLER COMPLETED April 14, 1951

LOCATION South side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
19 ft.	Clay, stones	19 ft.		
6 ft.	Clay	25 ft.		
46 ft.	Shale	71 ft.		
12 ft.	Yellow sandrock	83 ft.		28 ft.
13 ft.	Grey shale	96 ft.		28 ft.
49 ft.	Yellow sandrock	145 ft.		28 ft.
23 ft.	White sandrock	168 ft.		28 ft.
32 ft.	Shale, sandy shells	200 ft.		28 ft.
25 ft.	Shale	225 ft.		28 ft.

Total depth 225 ft.

Well cased with 29'-3" of 12" - 51 lb. steel drive pipe with steel drive shoe.

Initial test 125 g.p.m. at 110 ft. pumping level

Shot well as follows:
- 50 lb. 60% Dynamite at 160 ft.
- 50 lb. 60% Dynamite at 145 ft.
- 50 lb. 60% Dynamite at 130 ft.
- 50 lb. 60% Dynamite at 115 ft.

Final test 500 g.p.m. at 105 ft. pumping level
550 g.p.m. at 120 ft. pumping level

THE OHIO DRILLING CO.
INCORPORATED
MASSILLON, OHIO

DRILLED FOR Ekco Products Company, Massillon Aluminum Division
Massillon, Ohio
HOLE NO. 2 - 12" Wel

DRILLED BY Herb Dyer DRILLER

COMPLETED January 30, 1953

LOCATION East side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
12 ft.	Cinders, fill	12 ft.		
23 ft.	Clay, stones	35 ft.		
12 ft.	Sand, gravel, clay	47 ft.		
21 ft.	Clay, gravel	68 ft.		
8 ft.	Broken sandrock, shale	76 ft.		
9 ft.	Shale	85 ft.		
60 ft.	Sandrock, yellow	145 ft.		
23 ft.	Sandrock, gray	168 ft.		
22 ft.	Shale with streaks of sandrock	190 ft.		
35 ft.	Shale, gray	225 ft.		

Water level - 34 ft.

Well cased with 84'-8" of 12"-51# steel drive pipe, fitted with drive shoe.

Well shot 4 times, each shot was 50# of 50% N.G. dynamite. Shots were at 125', 137', 149', and 161'.

After completion, top of 12" casing was extended 6 ft. above surface and this will be filled, therefore depth of well will be approximately 231 ft., and overall length of 12" casing will be approximately 90'-8".

470 gpm - 90 ft draw down

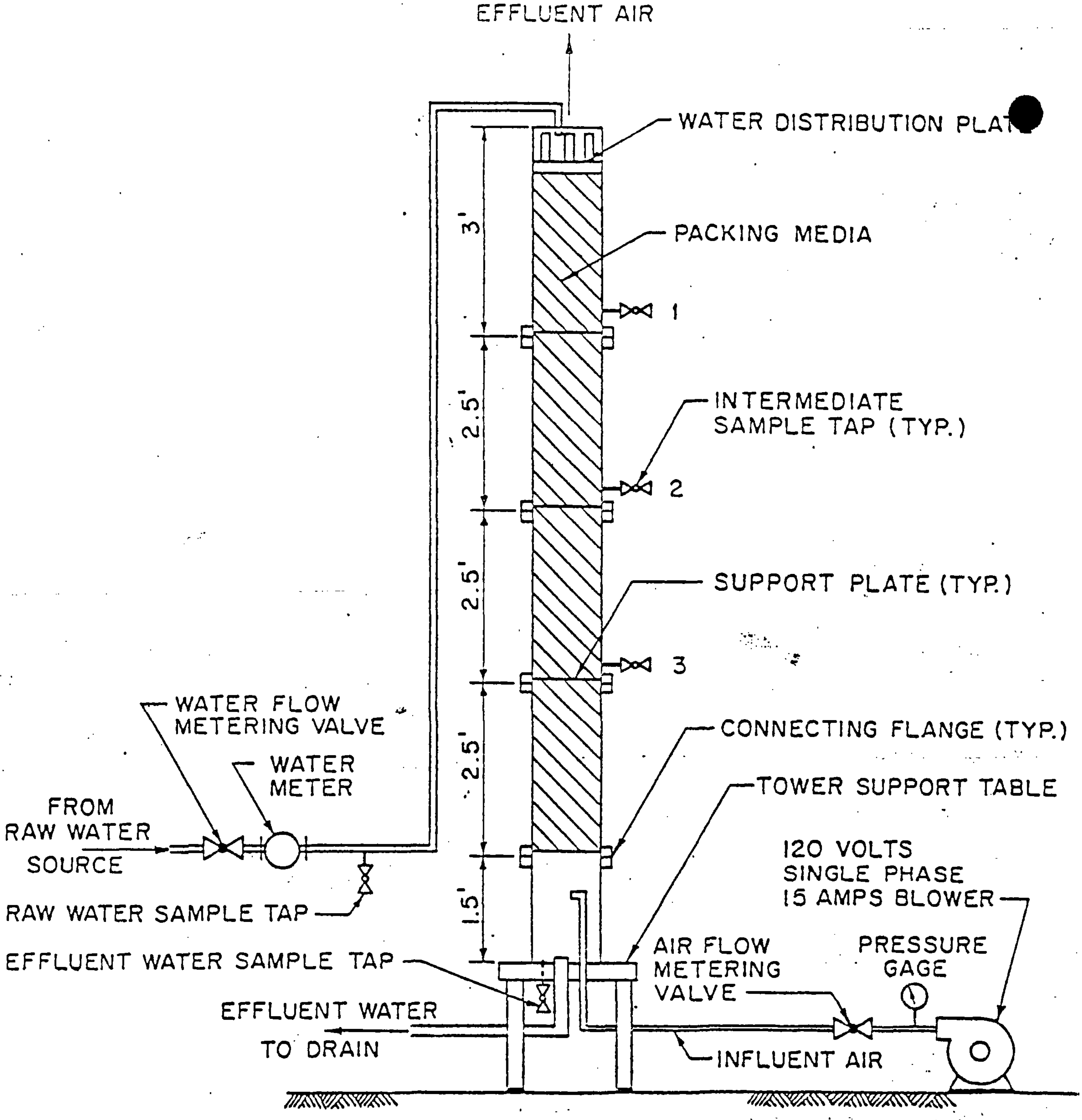


DIAGRAM OF PILOT AERATION COLUMN

size - diameter

air/water ratio ~ 30:1

9-28-84

Ekco Housewares

Distance – Drawdown Computations

1. Compute T from test: $T = \dfrac{264 \times Q}{\Delta s}$

$$T_{well1} = \frac{264 \times 425}{6.55} = 17{,}130 \text{ gpd/ft}$$

$$T_{well_2} = \frac{265 \times 425}{8.00} = 14{,}025 \text{ gpd/ft}$$

2. Additional data for computation of Theor. distance-drawdown rel.:

t = 90 days

S = 0.003 assumed   coefficient of storage

Q = 300 gpm – high est. of water pumped for cooling water

3. Formulas: $\text{drawdown}(s) = \dfrac{114.6\,Q}{T} W(u)$

$$W(u) = \int_u^\infty \frac{e^{-u}}{u}\,du$$

$$u = \frac{1.87 r^2 S}{Tt}$$

4.

	distance (r) from well	Estimated Drawdown at r
Well #1	50'	26.55'
large, steep cone	100'	23.15'
	1000'	11.87'
	5000'	4.24'
Well #2	50'	22.14'
	100'	19.36'
	1000'	10.12'
	5000'	3.83'

Well #2

VOLATILE COMPOUNDS ANALYTICAL REPORT

Company: Ekco Housewares
Sample Identification: W #2, 8/17/84
Laboratory Identification: 79126
Sample Matrix: Water

Benzene	ND	trans-1,2-Dichloroethene	ND
Bis(chloromethyl)ether	ND	1,2-Dichloroptopane	ND
Bromodichloromethane	ND	cis-1,3-Dichloropropene	ND
Bromoform	ND	trans-1,3-Dichloropropene	ND
Bromomethane	ND	Ethylbenzene	60 ug/L
Carbon tetrachloride	ND	Methylene chloride	ND
Chlorobenzene	ND	1,1,2,2-Tetrachloroethane	ND
Chloroethane	ND	Tetrachloroethene	ND
2-Chloroethylvinyl ether	ND	Toluene	20 ug/L
Chloroform	ND	1,1,1-Trichloroethane	46 ug/L
Chloromethane	ND	1,1,2-Trichloroethane	ND
Dibromochloromethane	ND	Trichloroethene	82 ug/L
Dichlorodifluoromethane	ND	Trichlorofluoromethane	ND
1,1-Dichloroethane	120 ug/L	Vinyl chloride	ND
1,2-Dichloroethane	ND		
1,1-Dichloroethene	13 ug/L		

Note: ND (None detected, lower detectable limit = 10 ug/L)

higher conc. in well #1

MS/DS IDENTIFIED NON REGULATED COMPOUNDS WITH ESTIMATED VALUES

Company: Ekco Housewares
Sample Identification: W #2, 8/17/84
Laboratory Identification: 79126
Sample Matrix: Water

Xylenes	210 ug/L

WESTON
MANAGERS DESIGNERS/CONSULTANTS
WESTON WAY
WEST CHESTER, PA 19380
PHONE: 215-692-3030
TELEX: 83-5348

4 January 1989

Ms. Sally Averill
Project Manager
Hazardous Waste Enforcement Branch
U.S. Environmental Protection Agency Region V
230 South Dearborn Street
Chicago, IL 60604 W.O. No. 2994-02-03

RE: Revised Groundwater Quality Assessment Report
EKCO Housewares, Massillon, Ohio

Dear Ms. Averill:

Enclosed please find three (3) copies of the revised "Groundwater Quality Assessment Report for EKCO Housewares, Inc., Massillon, Ohio". The report has been revised in response to comments received from U.S.EPA and the Ohio EPA in your letter dated 26 October, 1989. Also enclosed as an attachment to this letter is a list of specific responses to each of your comments, in accordance with our discussion in your offices on 27 November, 1989. The responses follow the comments as numbered in your letter from Mr. William Muno to Mr. Thomas Shingleton of EKCO Housewares.

Several comments, especially in the "General Comments" section of your letter, and several comments received from Ohio EPA, refer to the RFI/CMS Work Plan rather than the Groundwater Quality Assessment Report. In the response table (Attachments A and B), we have noted each of these; responses will be deferred until receipt of the full set of comments regarding the RFI/CMS Work Plan.

We appreciate your continued cooperation with this important project. If you have any questions regarding the enclosed, please contact either Mr. Timothy McGuinness, of American Home

Products, at (212) 878-5769, or the undersigned at (215) 344-3643.

Very truly yours,

ROY F. WESTON, INC.

Harold G Byer

Harold G. Byer
Project Manager

Attachments A and B
Enclosures
cc: T. McGuinness, AHP w/enclosures
T. Shingleton, EKCO w/enclosures

WESTON

ATTACHMENT A

U.S. EPA COMMENTS

U.S. EPA Comment No.	Response
1.	Available information has been added to the text.
2.	TCA was used in the interim. The revision has been made.
3.	The two referenced permits have been included in Appendix H. A reference is provided in the text.
4.	The text has been revised. The surface impoundment was diverted to Newman Creek. The lagoon was used intermittently from 1981 through 1984.
5.	The referenced information from earlier effort has been added to Section 1.
6.	The referenced maps have been included in Section 1.
7.	The reference has been corrected.
8.	The reference to Schmidt was correct. The title to Table 1-1 has been revised as requested.
9.	Well OWS-4 was abandoned because vinyl chloride was detected above the drinking water standard.
10.	The pump and treat system was started in 1986. The typographic error has been corrected.
11.	The log for well W-1 shows 116 feet of shale and 84 feet of sandstone. The description, as suggested in your comment, would be inappropriate. The text has been revised to more accurately describe the bedrock as shown in the well log.

12. The text has been revised.

13. The "L" wells were installed close to the lagoon to serve as compliance wells for the RCRA program.

14. The text has been revised. Major physical structures in this case refer to buildings.

15. The USGS benchmark has been indicated on Figure 2-1.

16. The text has been revised to indicate that the grid system is shown on the computer calibration and simulation maps in Section 4.

17. The text has been revised.

18. The text has been revised. Structures surveyed for general horizontal reference were buildings. The surveying was primarily for vertical elevation control on the monitor wells.

19. The point source map has been included.

20. The text has been revised. The Figure has been revised.

21. The text has been revised.

22. The point source map has been included.

23. The text has been revised.

24. The point source map has been included.

25. The text has been revised and the average values have also been included.

26. The text has been revised.

27. The additional information has been included.

28. The reference to the VOC figures has been revised.

29. The text has been revised.

30. The text has been revised to show that no nearby fuel sources have been identified. It is important to note that the BTXE compounds have been detected at their highest concentrations offsite near the old inactive landfill. Conversations with representatives of Ohio Water Service indicated that no underground or above ground fuel storage tanks are or have been used at their facility.

31. This comment has been deleted at the request of U.S. EPA.

32. The fourth compound is acetone. The text has been revised.

33. The text has been revised to show that methylene chloride was detected in all laboratory blanks.

34. The text has been revised to indicate that several sources are possible for the VOCs detected in the discharge water in the pipe. Further, a camera survey of the pipe was completed. No breaks were identified in the camera survey.

35. The text has been revised to indicate that the method of surface water discharge measurement is relatively inaccurate. The results should be used only for order of magnitude estimation of flow.

36. The text has been revised to show that the contaminant of concern was found in the associated blank samples.

37. The text has been revised to show that transmissivity and storativity are variable throughout the area. Anisotropic conditions are not indicated, but rather heterogeneous conditions are present.

38. The reference for storativity values has been included.

WESTON

39. Comment noted.

40. The text has been revised. We agree that the data indicate a connection between bedrock and unconsolidated materials. The word "minor" has been deleted.

41. Comment noted.

42. It is clear and well documented that pumping rate is a primary factor in the size of a cone of influence. The rate of spread does depend upon transmissivity, storativity and time of pumping as you suggest. However, the rate of spread also depends upon pumping rate. Your reference, included in your comment No. 53 uses for support a formula which is the reciprocal of the formula for calculating storativity from a semi-log plot of drawdown versus time. Although pumping rate is not a term in that formula, pumping rate is intrinsic to the semi-log plot itself. A change in pumping rate will change the slope of the curve, and hence (by the formula you used in Comment 53) the zero intercept, and hence the size of the cone.

43. The text has been revised.

44. The text has been revised to say "outcrop".

45. The term "bedrock subcrop" has been deleted.

46. The term has been changed to "bedrock high". The term has been defined. The term "slope" has been deleted.

47. The text has been revised. The interconnection between the zones has not been ignored. In fact, interconnection is a primary assumption in the modeling.

48. The term "regime" has been changed to "system".

49. The terminology has been revised. The purpose for the computer simulation is to provide a tool in evaluating potential remedial scenarios during the later stages

of the RFI/CMS. Further calibration of the model will occur as additional data become available.

50. The statement that fill materials become less compacted with depth is an observation of conditions encountered during our investigation. This type of condition is not unusual for artificial fill. It may have resulted due to the method of fill, i.e., relatively thick layers deposited at one time without compaction at intermediate depths. An alternate or perhaps additional cause of this condition would be vehicular traffic on the fully emplaced fill materials.

51. The 5 wells L-1 through L-5 were installed around the lagoon to serve as RCRA compliance points. These are the only reliable wells screened in the fill materials.

52. The data mapped for groundwater flow in the "L" wells were collected over a period of approximately 18 months. The text has been revised to show that these conditions, although likely reflecting the artificial influence of onsite pumping, are relatively static.

53. As stated in our response to Comment 42, the pumping rate is a very important factor in the size of a cone of influence. Again, the formula supplied in your comment for calculating the point of zero drawdown has been taken from standard references showing means of calculating storativity from semi-log plots of time versus drawdown. Hence, a pumping rate is already implied. As pumping rate changes, the slope of the time drawdown line changes, and the zero intercept changes.

54. The gradient near the lagoon probably increases toward the plant due to the pumping influence of well W-10. The text has been revised.

WESTON

The figure (Figure 3-20) has been revised.

The figure (Figure 3-20) has been revised to include water levels in P-3 and P-4.

55. The text has been corrected.

56. The text has been revised to indicate how the dewatered zone was estimated. We used water elevations and showed the eastern edge of the dewatered zone to correspond with the estimated point at which the water table in the unconsolidated aquifer would contact bedrock.

57. The figure (Figure 3-20) has been revised.

We agree that the "interface" zone is hydraulically connected with the bedrock aquifer. Again, this is a basic assumption in our modeling effort.

58. The text has been qualified to indicate that groundwater gradients in the area are all artificially influenced by pumping. We have used the best information available, and do not believe that the values used were arbitrary.

59. The terminology applied to the different hydrologic zones has been clarified. The model has used the term "layers" as this is what is called for in the model.

60. The text has been revised. The difference in terms of calibration is between the calibrated heads and the water levels as measured in 1988.

The model has been set-up such that the thickness of layer 2, the bedrock aquifer, is constant and sloping to the east. The results of calibration suggests this to be an appropriate approach.

For hydraulic conductivity in layer 1, we applied the available hydraulic conductivity information. No values were available for

WESTON

the OWS wells. The values used for the area including the OWS wells provided simulated drawdowns which closely matched the observed drawdowns. The difference in terminology between layer 1 and layer 2 is a requirement of the model MODFLOW.

The calibration maps were done without using the water levels in well I-8. The model will be recalibrated using well I-8 and any new wells installed during the RFI/CMS investigation.

The calibrated maps show that the shallow or unconsolidated and bedrock layers are hydraulically connected at the site. The head variations in the shallow layer caused by the hypothetical pumping rate applied to well OWS-1 are directly transmitted to the layer below. A simple way to understand these interconnected conditions is to recognize that the pressure surface for the bedrock wells is at an elevation which intersects the unconsolidated aquifer cone.

61. The text has been modified. We do not understand what is intended with the second part of your comment. The conductivity values are simply put in scientific notation form as derived.

62. Our bedrock surface map is based upon actual data down to the 825 foot elevation contour. Other contours beyond this point were drawn based upon the general shape of that contour, i.e., the simplest interpretation based upon available data. We do not agree that buried valleys "usually have steep walls and a fairly flat floor". Our experience suggests that many configurations are possible. The location of the river does not necessarily indicate the center or deepest portion of the buried valley.

63. Several attempts were made to incorporate the water levels recognized in the fill materials into the model. It is apparent that conditions in the lagoon area may be beyond the models capability. However, because the primary purpose of the model is

WESTON

to evaluate various pumping scenarios on off-site ground water flow, we do not feel that this represents a major problem. Please note that the suggestion provided in the final sentence of comment 63 is precisely what was done for layer 1 in the model.

64. The text has been revised to provide the figure numbers in the location indicated.

65. The simmulation was a steady-state model run. The model assumed that the wells were never on.

66. Again, as stated in the response to Comment 60, the shallow and bedrock layers are hydraulically connected at the site and in the simulation. The head variation in the unconsolidated (shallow) layer caused by the hypothetical pumping rate applied to well OWS-4 are directly transmitted to the layer below.

67. The contours for layer 1 have not been chopped off. The line indicates the estimated dewatered zone. The figures have been modified to make this more clear.

68. The text has been modified to show the pumping rates which were also indicated on the simulation maps. It is not clear at this time whether or not a well or wells could be installed at that location to supply the volume of water as simulated. The point of the model is to evaluate potential schemes for obtaining complete hydraulic control, effective recovery, and no risk to groundwater users. This information, as refined during the RFI/CMS will be invaluable.

General Comments

1-8 These general comments, as stated in the cover letter, apply to the RFI/CMS Work Plan. The response will be deferred until receipt of all comments regarding that Work Plan.

ATTACHMENT B

OHIO EPA COMMENTS

Ohio EPA Comment No.	Response
1.	The text has been revised. The piezometers can only be relied upon for groundwater flow evaluation purposes.
2.	Comment noted. The "L" wells are now being sampled on a quarterly basis.
3.	Response deferred until receipt of all comments regarding the RFI/CMS Work Plan.
4.	Response deferred until receipt of all comments regarding the RFI/CMS Work Plan.
5.	Response deferred until receipt of all comments regarding RFI/CMS Work Plan.
6.	Response deferred until receipt of all comments regarding RFI/CMS Work Plan.
7.	The inorganic results for groundwater in Appendix D were mislabeled. The results should read micrograms per liter. The tables have been revised.
8.	Response deferred until all comments regarding RFI/CMS Work Plan have been received.
9.	The procedures and results of the dense phase sampling have been included.
10.	Response deferred until all comments regarding RFI/CMS Work Plan are received.
11.	Response deferred until all comments regarding RFI/CMS Work Plan are received.

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Figures

1. The line questioned on the map is a fence.

2. The map selected is intended to serve only as a general reference. We could not locate any general maps showing the setting in a more germane manner.

3. The terminology will be changed to "few residential wells".

4. The legend on Figure 1-6 will be modified. The piezometer will be removed.

5. The figure does not show anisotropic conditions. The shape of the cone shows the long axis of the cone parallel to a line bisecting the two pumping wells. We concur, however, that the aquifers in the area are relatively heterogenous.

6. The maps have been revised.

7. The figure has been removed. We have replaced the figure with a table showing the thicknesses of the fill materials as interpreted from the well logs.

8. The cross-sections, Figures 3-16, and 3-17, have been revised.

9. The figure has been revised.

10. The figure has been revised.

11. The figure has been revised.

12. The figure has been revised.

13. The figure has been revised.

14. The figure has been revised.

15. The figure has been revised.

16. The figure has been revised.

17. The figure has been revised.

WESTON

18. The figure has been revised. The estimated dewatered zone is based upon the estimated points at which the contours would intersect the corresponding elevation of the bedrock surface. All available data has been used in recontouring Figure 3-20. Drawdown did not occur in all deep, shallow, and interface wells when W-10 was pumped.

19. The correction has been made.

20. The correction has been made.

21. Comment noted.

WADSWORTH
TESTING
LABORATORIES,
INC.

P.O. Box 208, 1600 Fourth Street, S.E., Canton, Ohio 44701 (216) 454-5809

REPORT OF ANALYSIS

Ekco Housewares
P.O. Box 560
Massillon, Ohio 44648

Attention: Mr. Leo Hahn

RECEIVED
MAY 22 1986
U.S. EPA, REGION V
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE ENFORCEMENT BRANCH

Sample Description: Water samples from Newman Creek

Laboratory I.D. Number: 92777

Date Sample Received: 11/6/85

Date of Report: 11/19/85

TOTAL DISSOLVED METALS

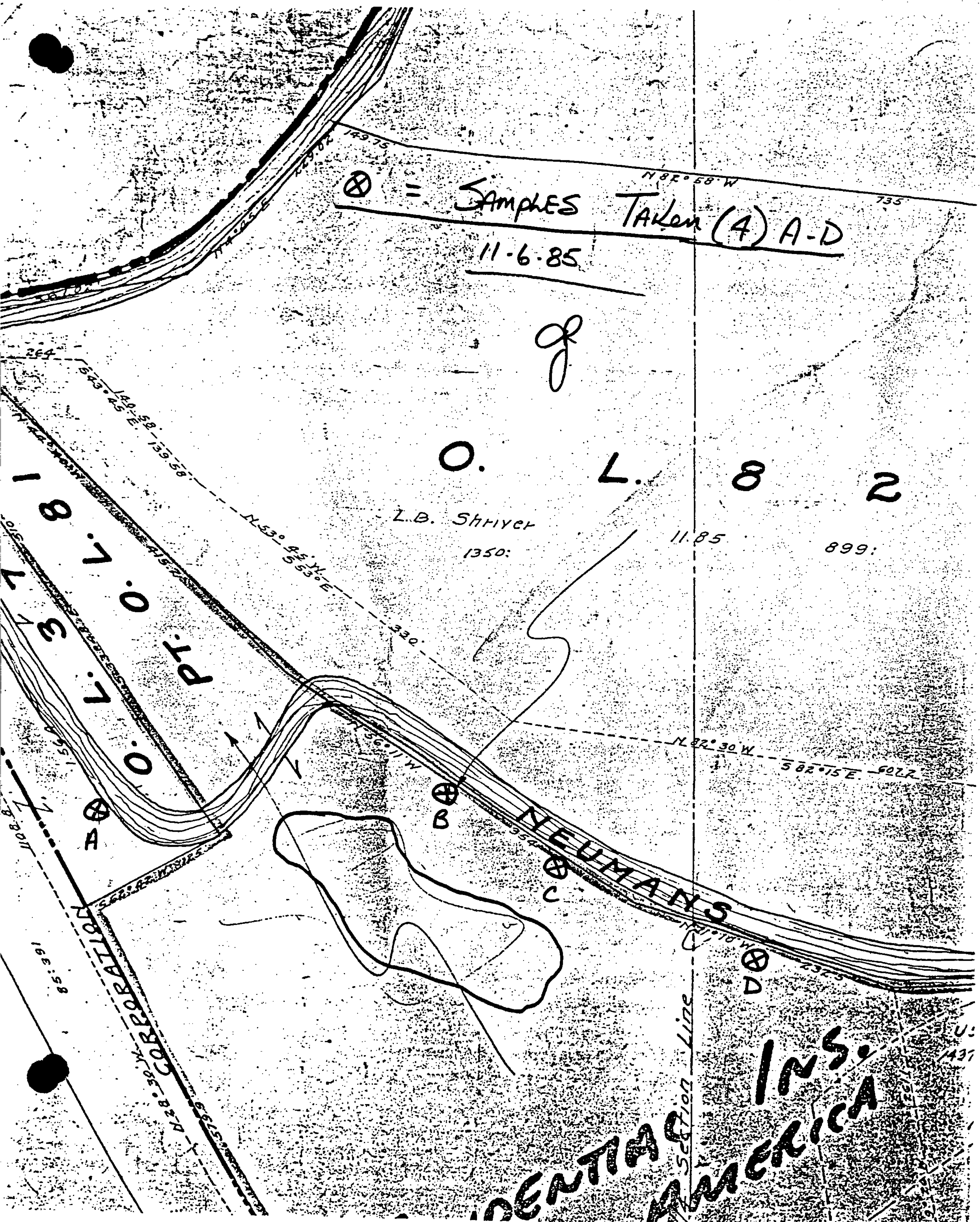
	Sample A	Sample B	Sample C	Sample D
Arsenic	<0.005 mg/L	<0.005 mg/L	<0.005 mg/L	<0.005 mg/L
Barium	<0.1	<0.1	<0.1	<0.1
Cadmium	<0.01	<0.01	<0.01	<0.01
Chromium	<0.02	<0.02	<0.02	<0.02
Hexavalent chromium	<0.02	<0.02	<0.02	<0.02
Lead	<0.05	<0.05	<0.05	<0.05
Mercury	<0.002	<0.002	<0.002	<0.002
Selenium	<0.005	<0.005	<0.005	<0.005
Silver	<0.01	<0.01	<0.01	<0.01

(Copy To T. Shingleton
J. Epps)

11/21/85

WADSWORTH TESTING LABORATORIES, INC.

Marvin Stephens /PK



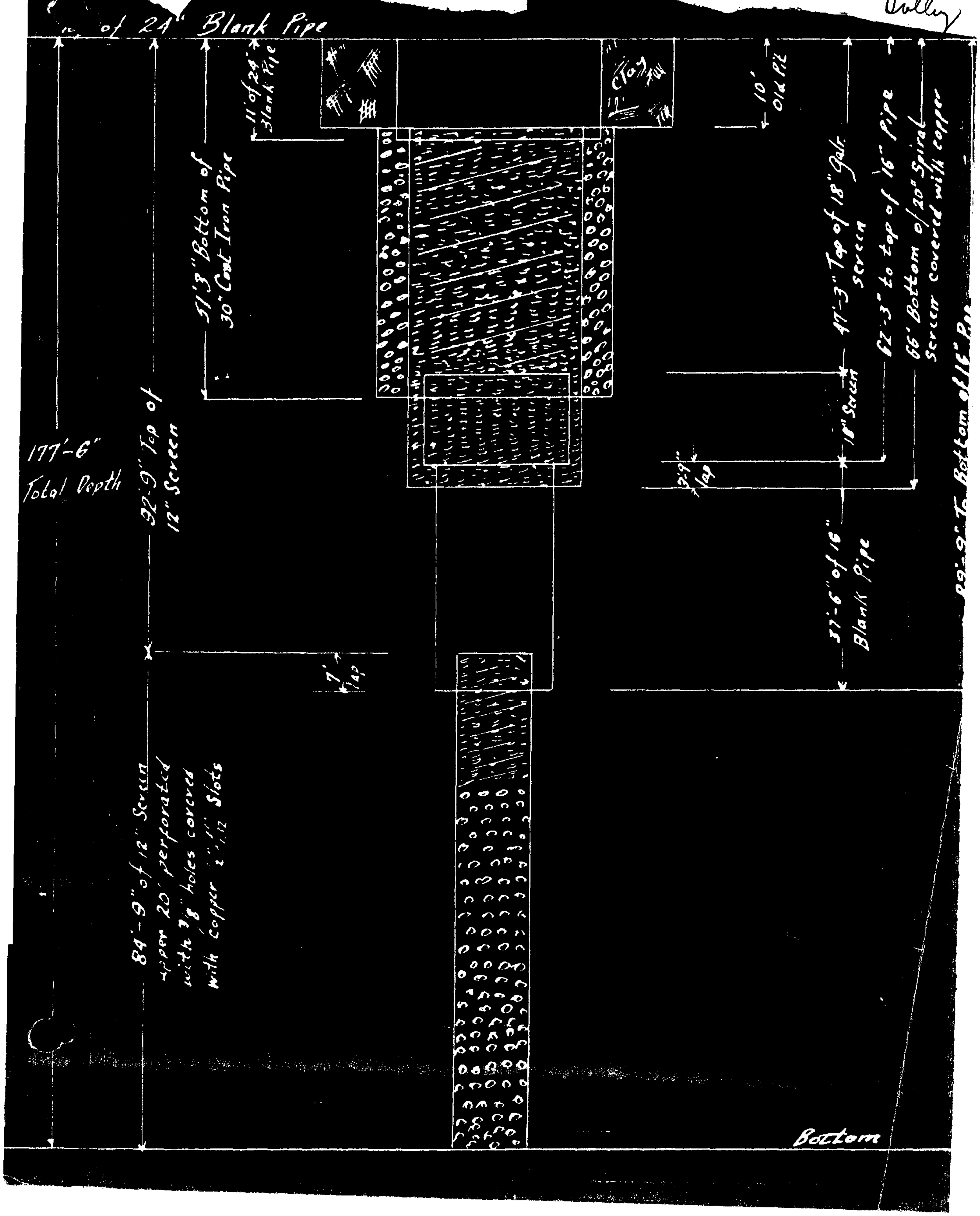
⊗ = SAmples Taken (4) A-D
11-6-85
O. L. 8 2
L.B. Shriver
1350:
11.85
899:
N 82° 58' W
735
149.75
264
N 53° 45' W
S 53° E
330
N 82° 30 W
S 82° 15 E
N 56° 11' W
O. L. 30 PT. O. L. 18 7
NEUMANS
A
B
C
D
CORPORATION
Section Line
PRUDENTIAL INS. AMERICA
N 28° 30 W
1108.8
85:391

#4 well across from waterplant

MASSILLON WELL #4

→ VINYL CHLORIDE 9.4 ppb

1-14-86
From Ohio Valley



LOG FOR #4 WELL

September 20, 1918.

6" Test well inside of large well at Massillon Pumping Station, south east corner of property along drive.

Depth of test taken.	
48 ft.	Sand and little clay and gravel (little water)
56 ft.	Sand with very little clay (water)
68 ft.	Sand, gravel and clay (no water)
78 ft.	Gravel and clay (no water)
88 ft.	Gravel and heavy clay, mostly clay (no water)
98 ft.	Sand and gravel with little clay (little water)
108 ft.	Sand and gravel with very little clay (more water, looks favorable at this point)
116 ft.	Sand and gravel (more water, looking good)
126 ft.	Sand and gravel (strong flow of water, gravel very loose and bails out good)
131 ft.	Same as test at 126 ft.
143 ft.	Same as test at 126 ft.

Samples taken at each test and delivered to office.

Test hole was stopped at 143 ft.

Theo Updegraff,

Driller.

Suggested Procedure for Removal of Volatile Organic Chemicals from the Ground Water at Ekco Housewares Massillon, Ohio

The following procedure is subject to change as additional information is gathered during the investigative phase.

I Investigative Phase

1. Test holes will be drilled at the Ekco plant site to gather additional hydrogeologic information. Samples of the soils and ground water will be collected for chemical analysis.

2. The shape and size of the contaminant plume on the Ekco property will be determined.

3. A contour map of the piezometric surface will be drawn so that direction and velocity of ground water movement can be estimated.

4. Pumping data will be studied and a mathematical model of the wells will be developed so that the cone of depression produced by the plant's pumping can be approximated.

II Removal of the Contaminated Ground Water

1. If required, additional removal wells will be designed to pump the pollutant from the aquifer.

2. The site of the well or wells will be determined from the aquifer study and the location of the highest concentrations of the contaminant.

III Water Treatment Equipment

1. Water pumped from the removal wells will be treated to remove the VOCs before discharging to a stream.

2. If deemed necessary, a pilot air stripper will be erected to determine the design criteria for a permanent air stripper.

3. A consulting engineering firm will be hired to design the permanent equipment.

4. The Ohio Drilling Company will fabricate and erect the permanent air stripper.

5. The influent to the stripper and the discharge will be sampled at regular intervals to determine the efficiency of the tower.

Pollutants easy to strip.

IV Cleanup of the Aquifer

1. Water samples will be collected occasionally from the removal wells and water sample wells for chemical analysis.

2. The shrinking of the contaminant plume will be monitored.

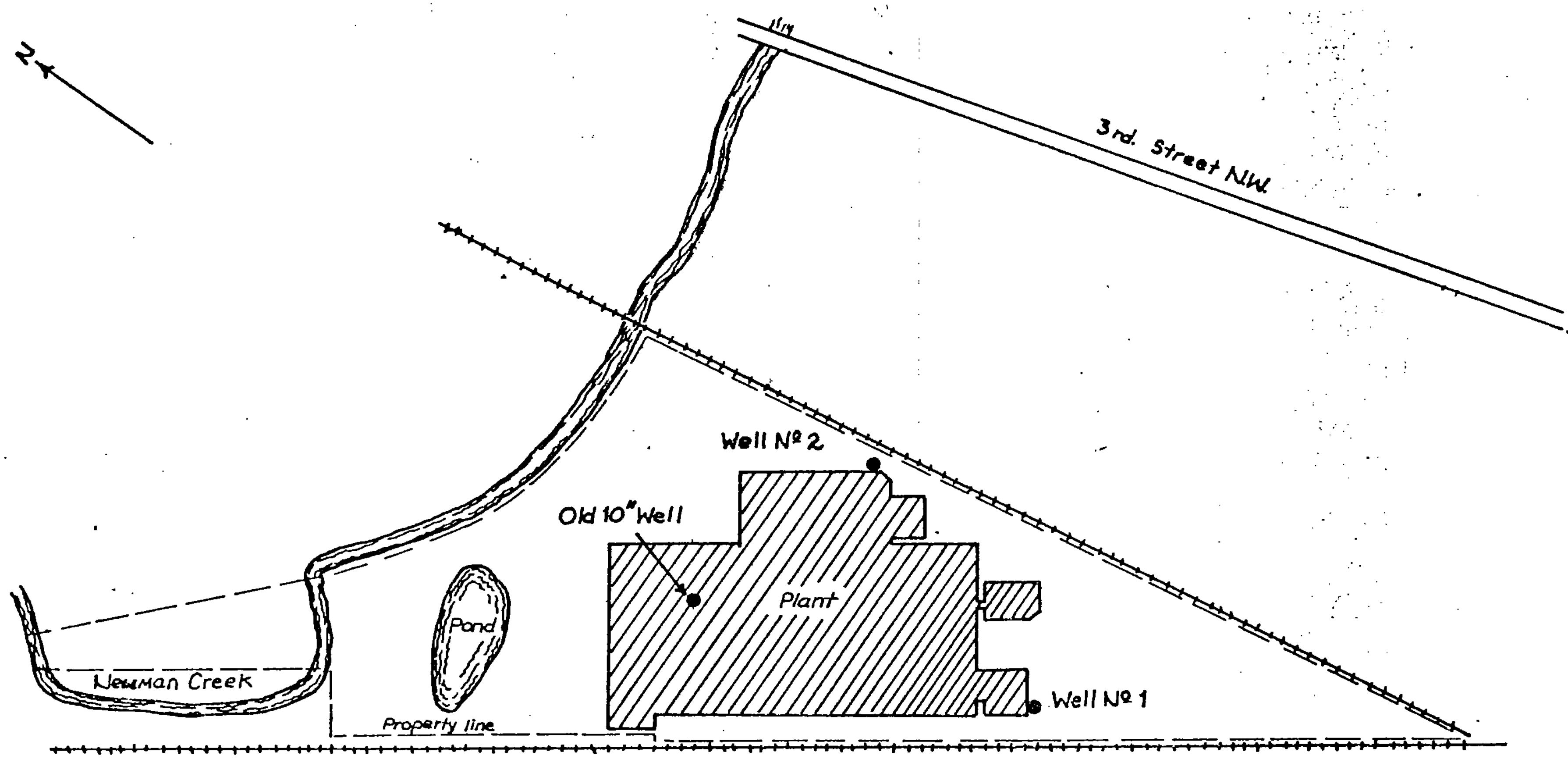
V Estimated Time to Complete the Work

1. It will take approximately four months to have an air stripper in operation.

2. The cleanup of the VOCs in the aquifer will take an extended period of time. The time required can be estimated after the investigative phase of the work is completed.

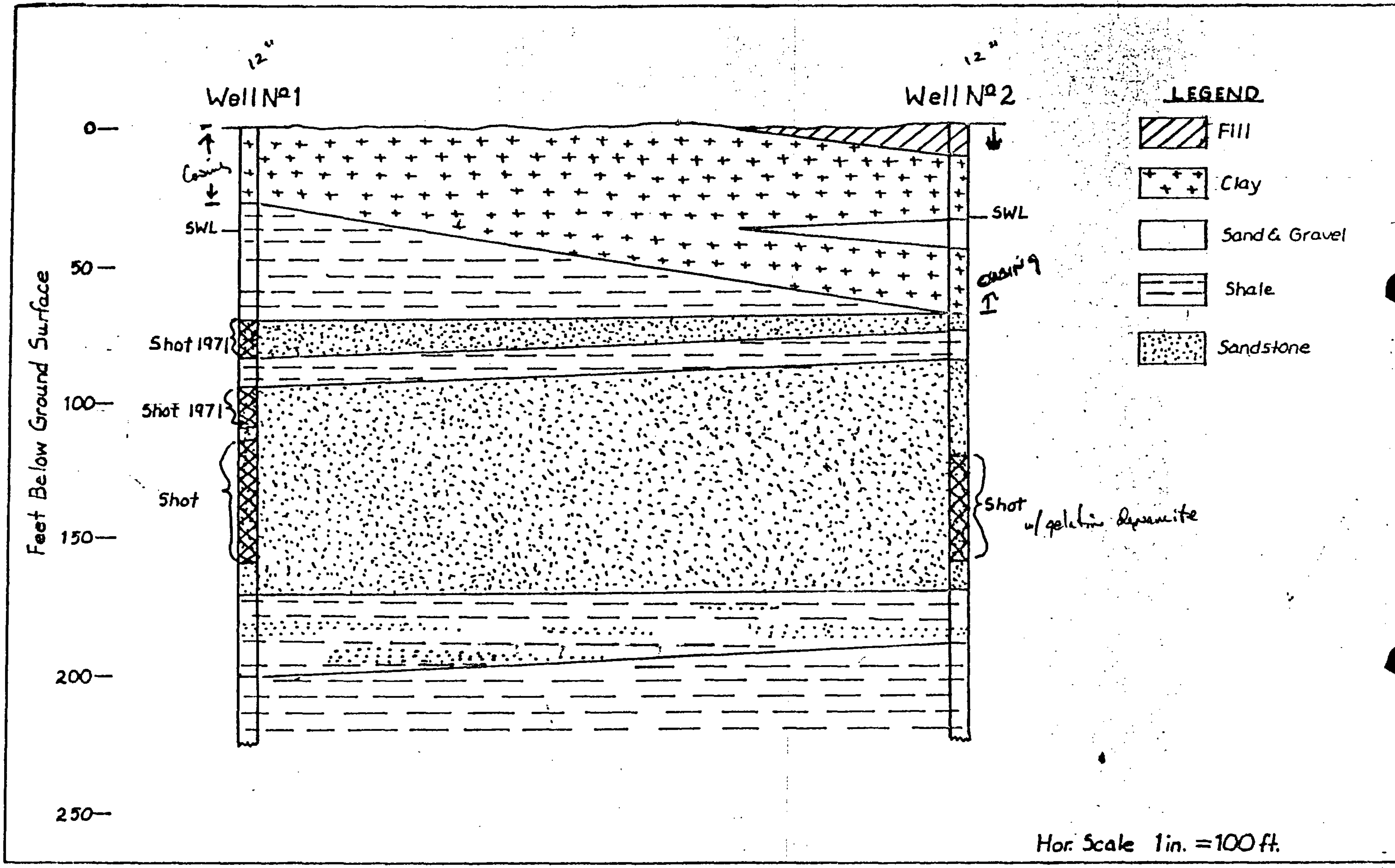
George H. Mayhew

George H. Mayhew, Ph.D.
Certified Professional Geologist



LOCATION PLAT - Do Not Scale

EKCO HOUSEWARES COMPANY, MASSILLON PLANT SITE



Geologic Cross-section SW-NE

EKCO HOUSEWARES COMPANY, MASSILLON PLANT

THE OHIO DRILLING CO.
INCORPORATED
MASSILLON, OHIO

DRILLED FOR Massillon Aluminum Company, Massillon, Ohio HOLE NO. 1 - 12" Well

DRILLED BY Herb Dyer DRILLER COMPLETED April 14, 1951

LOCATION South side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
19 ft.	Clay, stones	19 ft.		
6 ft.	Clay	25 ft.		
46 ft.	Shale	71 ft.		
12 ft.	Yellow sandrock	83 ft.		28 ft.
13 ft.	Gray shale	96 ft.		28 ft.
49 ft.	Yellow sandrock	145 ft.		28 ft.
23 ft.	White sandrock	168 ft.		28 ft.
32 ft.	Shale, sandy shells	200 ft.		28 ft.
25 ft.	Shale	225 ft.		28 ft.

Total depth 225 ft.

Well cased with 29'-3" of 12" - 51 lb. steel drive pipe with steel drive shoe.

Initial test 125 g.p.m. at 110 ft. pumping level

Shot well as follows:

50 lb. 60% Dynamite at 160 ft.
50 lb. 60% Dynamite at 145 ft.
50 lb. 60% Dynamite at 130 ft.
50 lb. 60% Dynamite at 115 ft.

Final test 500 g.p.m. at 105 ft. pumping level
550 g.p.m. at 120 ft. pumping level

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

DRILLED FOR Ekco Products Company, Massillon Aluminum Division HOLE NO. 2 - 12" Well
Massillon, Ohio

DRILLED BY Herb Dyer DRILLER COMPLETED January 30, 19 53

LOCATION East side of Plant

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
12 ft.	Cinders, fill	12 ft.		
23 ft.	Clay, stones	35 ft.		
12 ft.	Sand, gravel, clay	47 ft.		
21 ft.	Clay, gravel	68 ft.		
8 ft.	Broken sandrock, shale	76 ft.		
9 ft.	Shale	85 ft.		
60 ft.	Sandrock, yellow	145 ft.		
23 ft.	Sandrock, gray	168 ft.		
22 ft.	Shale with streaks of sandrock	190 ft.		
35 ft.	Shale, gray	225 ft.		

Water level - 34 ft.

Well cased with 84'-8" of 12"-51# steel drive pipe, fitted with drive shoe.

Well shot 4 times, each shot was 50# of 50% N.G. dynamite. Shots were at 125', 137', 149', and 161'.

After completion, top of 12" casing was extended 6 ft. above surface and this will be filled, therefore depth of well will be approximately 231 ft., and overall length of 12" casing will be approximately 90'-8".

470 gpm - 90 ft draw down

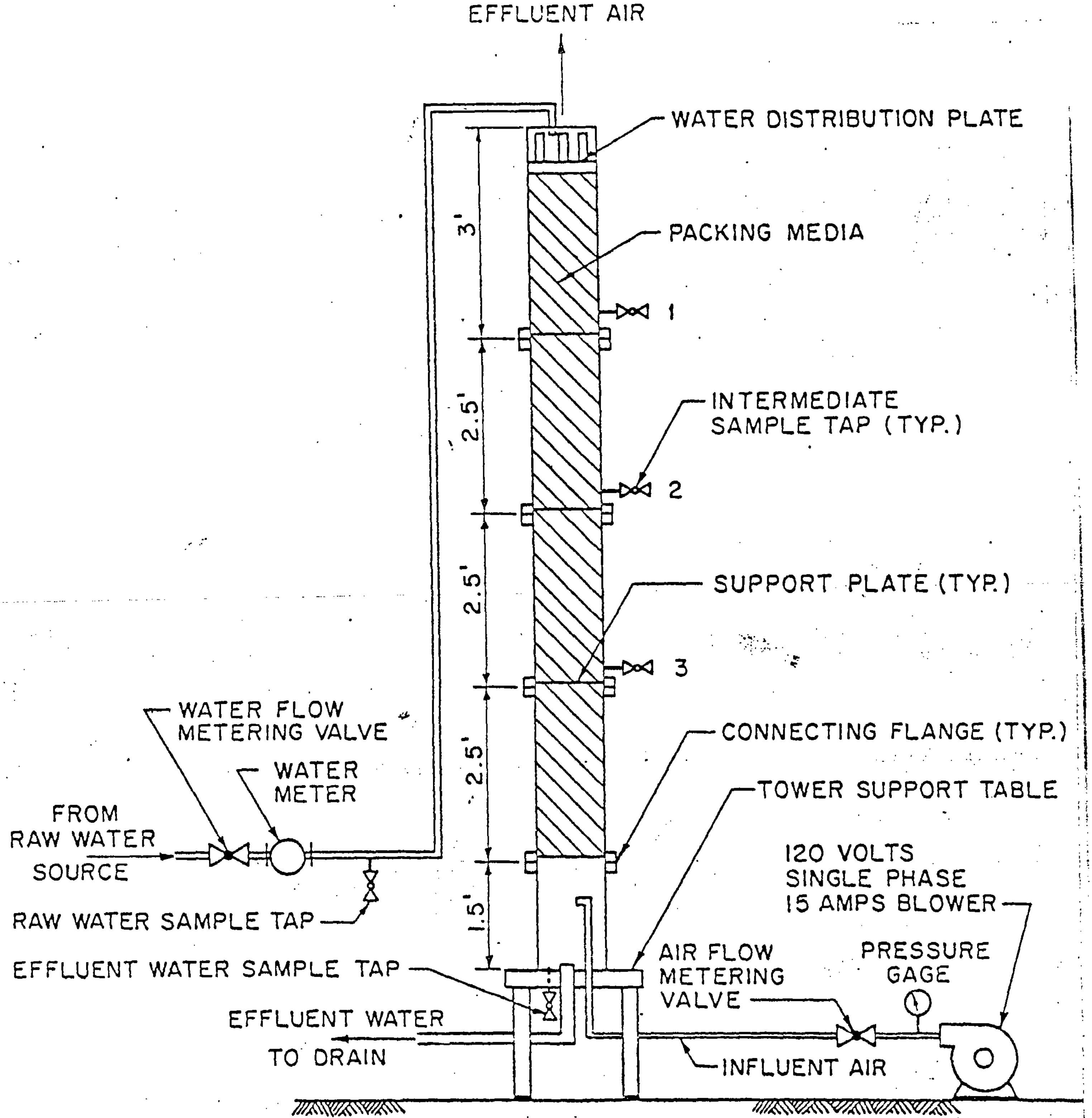


DIAGRAM OF PILOT AERATION COLUMN

size - diameter

air/water ratio — ~ 30:1

Ekco Housewares

Distance - Drawdown Computations

1. Compute T from test: $T = \frac{264 \times Q}{\Delta s}$

$$T_{well 1} = \frac{264 \times 425}{6.55} = 17,130 \text{ gpd/ft}$$

$$T_{well_2} = \frac{265 \times 425}{8.00} = 14,025 \text{ gpd/ft}$$

2. Additional data for computation of Theor. distance-drawdown rel.:

t = 90 days

S = 0.003 assumed   coefficient of storage

Q = 300 gpm - high est. of water pumped for cooling water

3. Formulas: $\text{drawdown}(s) = \frac{114.6 Q}{T} W(u)$

$$W(u) = \int_u^\infty \frac{e^{-u}}{u} du$$

$$u = \frac{1.87 r^2 S}{Tt}$$

4.

Well #1	distance (r) from well	Estimated Drawdown at r
	50'	26.55'
large, steep cone	100'	23.15'
	1000'	11.87'
	5000'	4.24'
Well #2	50'	22.14'
	100'	19.36'
	1000'	10.12'
	5000'	3.83'

Well #2

VOLATILE COMPOUNDS ANALYTICAL REPORT

Company: Ekco Housewares
Sample Identification: W #2, 8/17/84
Laboratory Identification: 79126
Sample Matrix: Water

Benzene	ND
Bis(chloromethyl)ether	ND
Bromodichloromethane	ND
Bromoform	ND
Bromomethane	ND
Carbon tetrachloride	ND
Chlorobenzene	ND
Chloroethane	ND
2-Chloroethylvinyl ether	ND
Chloroform	ND
Chloromethane	ND
Dibromochloromethane	ND
Dichlorodifluoromethane	ND
1,1-Dichloroethane	120 ug/L
1,2-Dichloroethane	ND
1,1-Dichloroethene	13 ug/L
trans-1,2-Dichloroethene	ND
1,2-Dichloropropane	ND
cis-1,3-Dichloropropene	ND
trans-1,3-Dichloropropene	ND
Ethylbenzene	60 ug/L
Methylene chloride	ND
1,1,2,2-Tetrachloroethane	ND
Tetrachloroethene	ND
Toluene	20 ug/L
1,1,1-Trichloroethane	46 ug/L
1,1,2-Trichloroethane	ND
Trichloroethene	82 ug/L
Trichlorofluoromethane	ND
Vinyl chloride	ND

Note: ND (None detected, lower detectable limit = 10 ug/L)

higher conc. in well #1

MS/DS IDENTIFIED NON REGULATED COMPOUNDS WITH ESTIMATED VALUES

Company: Ekco Housewares
Sample Identification: W #2, 8/17/84
Laboratory Identification: 79126
Sample Matrix: Water

Xylenes	210 ug/L

Metcalf & Eddy

MEMORANDUM

FILE:

DATE: April 15, 1988

TO: Jerry Myers

OFFICE:

FROM: Stan Norris

COMPANY:

SUBJECT: Review of Weston's revised Groundwater Quality Assessment Plan for Ecko Housewares, dated March 1988

The most important revisions to the GWQAP involve the proposed additional monitoring wells (see 3-2, 3-4, fig. 14). None of the proposed new wells are north of Newman Creeks, yet everyone at our Chicago meeting on March 11 seemed to agree that more information was needed in the area between Newman Creek and Water Service Co. wells 1, 2 and 3. I am aware that Ecko was negotiating for sites north of Newman Creek at the time of our meeting and that difficulties in getting permissions for off-site drilling werre expected. Perhaps we can assume that permission was denied for sites north of Newman Creek. If so, an appropriate statement should have been included.

On page 4-1 it states that "one upgradient well (L-3) will be installed to provide background groundwater quality data". It should be remembered that although the proposed site of well L-3 may be upgradient now from the lagoon, it may not have been before pumping to the air stripper commenced. At the time water from the lagoon may have moved towards, and discharged into, Newman Creek. If so, the shallow sediments at the proposed site of L-3 may still be contaminated and L-3 will not yield water of background quality.

The proposed well layout shown in Figure 14 should yield good control, on site, of water levels in the shallow sediments and in the sandstone aquifer. I would like to see at least one additional shallow well on the west side of the site, between the plant and the raiolroad, to round out the coverage in the shallow sediments. If that cannot, or won't be done we'll have to settle for the wells as proposed.

With respect to the "I" or bedrock interface wells I suggest that water levels be carefully monitored as the wells are put down to see whether changes occur with depth in the shallow sediments.

Other comments follow:

Cross section A-A', fig. 8, shows sandstone overlying "alternating layers of shale and sandstone". Both units should be designated as shown in cross section B-B', fig. 9, as "white, yellow, brown sandstone interbedded with thein layers of shale". Figure 8 suggest that logs of wells W-1 and W-2 were used to construct cross section A-A', but the logs of these wells, drilled in 1951 (p. 1-4), are not given in any of the documents I've seen relative to this site. If the logs are available they should be included.

A better well and pumpage history at the plant should have been provided, and should have been mentioned in our earlier reviews. When and why was well W-2 taken out of service (see p. 1-23), and when was well W-10 drilled, are among questions I would like to have answered.

If the intent in U.S. EPA's letter of February 25 to Ecko was to change "lagoon" or "evaporation lagoon" to surface impoundment throughout the text, it has not been done. See numerous pages and figures.

Page 2-9, Paragraph 2, Figure 11 locates the wells...2 would delete "the".

A-2, item 10. Data obtained by pumping a well in the sandstone cannot be used to determine T and S of the unconsolidated sediments.